THE PLANT DISEASE REPORTER

ISSUED BY THE OFFICE OF MYCOLOGY AND DISEASE SURVEY

Supplement 53

Diseases of Cereal and Forage Crops

In the United States in 1926

August 30, 1927

BUREAU OF PLANT INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE

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DISEASES OF CEREAL AND FORAGE CROPS IN THE UNITED STATES IN 1926.

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FOREWORD

This summary of diseases of cereal and forage crops has been prepared utilizing the same sources of information and following the same methods that have been employed in previous years. An additional feature of this year's compilation, however, is the inclusion of several maps and graphs showing the average losses from various diseases over a period of years.

The compilers wish to thank the collaborators and the various members of the Offices of Cereal Crops and Diseases and Vegetable and Forage Diseases for supplying information and for criticizing the manuscript.

SEED TREATMENT OF CEREALS

Considerable investigation of the various methods and chemicals best adapted for cereal seed treatment has been reported recently. This might be reported on briefly under four general headings as follows:-

1. Organic mercury compounds. "Bayer Compound," "Bayer Dust," "Germisan," "Semesan Jr.," "Uspulun," and others have been reported as adapted for the treatment of the several cereal diseases. Bunt of wheat was usually controlled by immersion in solutions of these compounds (2, 21). When applied as a dust they do not usually seem to be so effective as when in the liquid form (2). Loose smut of wheat usually has not been satisfactorily controlled by soaking in these solutions. On the other hand, Gibberella seedling blight and Helminthosporium blight were partially controlled by a 30 minutes soak in certain of these chemicals (5, 2).

Stimulating germination of wheat is reported as a worth while consideration (2) and R. S. Kirby states that soaking of wheat in a 1/4 per cent organic mercury solution for 5 to 10 minutes following hot water treatment offsets seed injury and supplements the hot water in controlling seed borne diseases.

The soaking of sweet corn and dent corn in organic mercury solutions apparently helps to control certain diseases such as Diplodia and Fusarium rots, and to cause a marked increase in the yield (18).

Reports of Leukel, Dickson and Johnson (10), Dickson (5), and Linfors (11), show that certain of these mercury compounds in the dust form give partial control of barley stripe and in the liquid form give practically complete control. In some varieties of barley, like Tennessee Winter, covered smut is satisfactorily controlled with the liquid (9, 11). Loose smut is controlled in certain barley varieties like Hybrid, No. 19, while in others such as Alpha the treatment is not successful.

The loose and covered smuts of oats were partially controlled by soaking in organic mercury compounds (11, 8). Thomas and Tilford (24) found that in the dust form many of them do not give satisfactory results but that a dust made by

mixing one part of copper acetate and two parts of mercuric chloride gave good control.

2. Copper Carbonate Dust. The copper carbonate dust treatment has generally been reported as giving satisfactory control (8) of bunt of wheat. For example, in Virginia 20 treated fields had an average of 0.1 per cent bunt while 31 untreated fields had an average of 5.2 per cent (Fromme and Godkin). In Pennsylvania a survey of 196 untreated and 85 treated fields showed 6.26 per cent in the untreated and 0.18 per cent in the treated. (Kirby)

In the West, where soil infestation with Tilletia tritici is general, the copper carbonate dust treatment is only a partial control for bunt of wheat. This was reported as being the case in 1926 by E. A. Lungren in Colorado and by H. E. Morris in Montana.

Concerning grades of copper carbonate, L. E. Melchers in Kansas states:

> "All in all the 50-55 per cent grades of copper carbonate give the best control and require only two ounces. The 18-20 per cent grades require 3 to 4 ounces for best results."

In Colorado, E. A. Lungren states that a survey of 150 farms where wheat had been treated showed that fields treated with fine 50-55 per cent copper carbonate dusts had an average of 0.7 per cent smut with a maximum infection of 10 per cent in a single field. Fields treated with 18 to 20 per cent copper carbonate had an average of 2.6 per cent smut and a maximum infection of 35 per cent in a single field.

The oat smuts are prevented in the hulless varieties by copper carbonate dust, but it is not a satisfactory treatment for smut in hulled varieties (26, 8).

Kernel smut of millet is satisfactorily controlled with two ounces of 55 per cent copper carbonate dust per bushel and the kernel smut of sorghum is controlled with either grade of copper carbonate as well as several kinds of dusting sulphur (14).

3. Hot Water Treatment. A new single bath treatment for the control of loose smut of wheat has been found by Tapke (23) to be effective and less injurious to the seed than the modified hot water treatment.

4. Formaldehyde. This chemical is still the standard in most states for the control of smut in hulled varieties of oats (8). It is reported by L. E. Melchers in Kansas to be a more efficient control for bunt than copper carbonate dust when the wheat seed is black with smut spores, and C. Gregory in Indiana reports that much formaldehyde was used instead of copper carbonate dust to avoid injury to the drills.

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D I S E A S E S O F C E R E A L S

W H E A T

WHEAT DISEASES IN GENERAL

The estimated percentage loss to the wheat crop from diseases in the United States during the past nine years has varied from about 8 per cent in 1925 to nearly 17 per cent in 1919. Climatic conditions, farm practices, and varieties apparently largely determine the sections of the country in which any one disease will be the most important, and each major wheat disease seemingly is more important in some sections than in others. Thus stem rust appears to be most important in the spring wheat section and in Texas, California, and Utah, bunt in the western states, scab in the corn belt, and loose smut in the Eastern United States. (See Figs.3-7).

The spring wheat area leads in total loss from diseases with the average loss of nearly one-fifth of its wheat crop. The smallest average loss in any important wheat growing region occurs in the Rocky Mountain and Pacific Coast States. New England apparently has the smallest percentage losses of any section, but wheat there is a minor crop.

Table 27 . Estimated percentage loss to wheat from the most important diseases, according to average estimates of plant disease survey collaborators.

Disease	Average percentage loss 1918 to 1925
Stem rust	4.05
Stinking smut	1.58
Wheat scab	1.33
Loose smut	1.11
Leaf rust	.99
Total - All Diseases	10.82

STINKING SMUT OF WHEAT CAUSED BY TILLETIA LAEVIS KUEHN AND T. TRITICI (BJERK.) WINT.

Stinking smut has been reported from every state except Florida. Until the last two years it was most prevalent in the Pacific Northwest, moderately common in the Middle West, and fairly scarce in the East. (See Figs. 4). During the last two years, however, it seems to have become much more prevalent in Kansas, Nebraska, and Colorado, and only slightly less so in eastern states such as Pennsylvania and Virginia.

In an effort to determine more definitely the distribution of the two species of smut in Eastern and Central United States, Tisdale, Leighty, and Boerner (14) examined 539 samples of smutty wheat collected during 1926 in 377 localities in 19 states and in one province of Canada. T. tritici occurred in samples from only four states, Minnesota, North Dakota, South Dakota and Montana. It was the predominating form in North and South Dakota, but was less prevalent than T. laevis in Minnesota and Montana. T. laevis was the only form collected in the other 14 states and in Ontario. It was further found that:

> "If the samples examined can be considered as representative, they furnish strong indications that T. tritici, in the upper Mississippi, and Missouri Valleys, is confined almost entirely if not entirely, to durum wheat."

In 1924, 1925, and 1926, stinking smut caused a larger total loss in the United States than any other wheat disease. Estimates sent in by collaborators in 37 states indicate that stinking smut in 1926 caused the largest loss ever recorded for this disease since records have been kept. It was the most destructive wheat disease in the following thirteen states: Pennsylvania, Delaware, Maryland, Virginia, North Carolina, Michigan, North Dakota, Nebraska, Kansas, Colorado, Idaho, Washington, and Oregon. (See Table 28).

Some preliminary studies on the relationship of smut discounts to total loss from smut were made in Pennsylvania by Kirby. The results indicated that the percentage of smut-balls in threshed but uncleaned wheat represented one-fifth

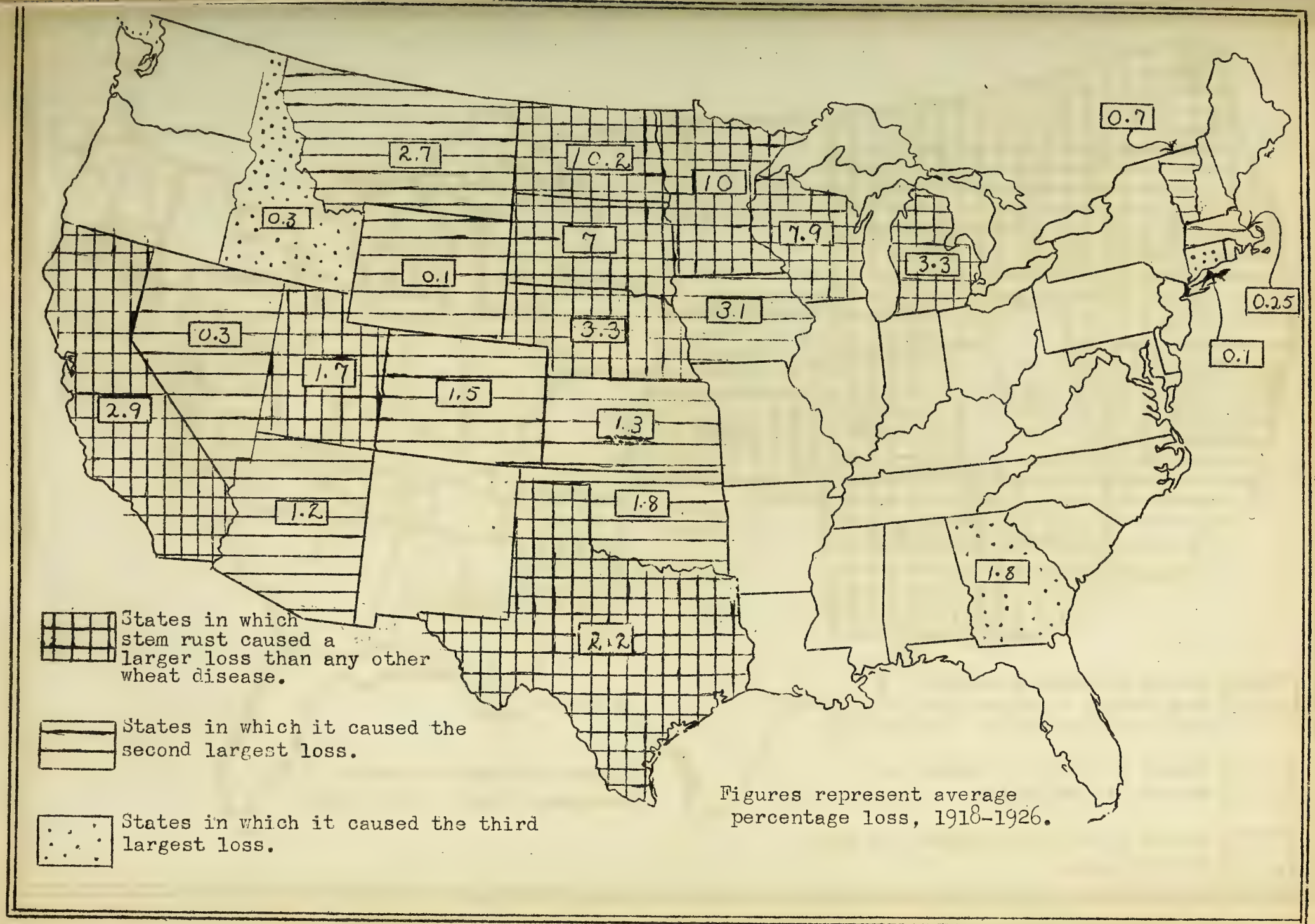

Fig. 3 States in which stem rust was the most destructive, second most destructive, and third most destructive of all wheat diseases, during 1918 to 1926.

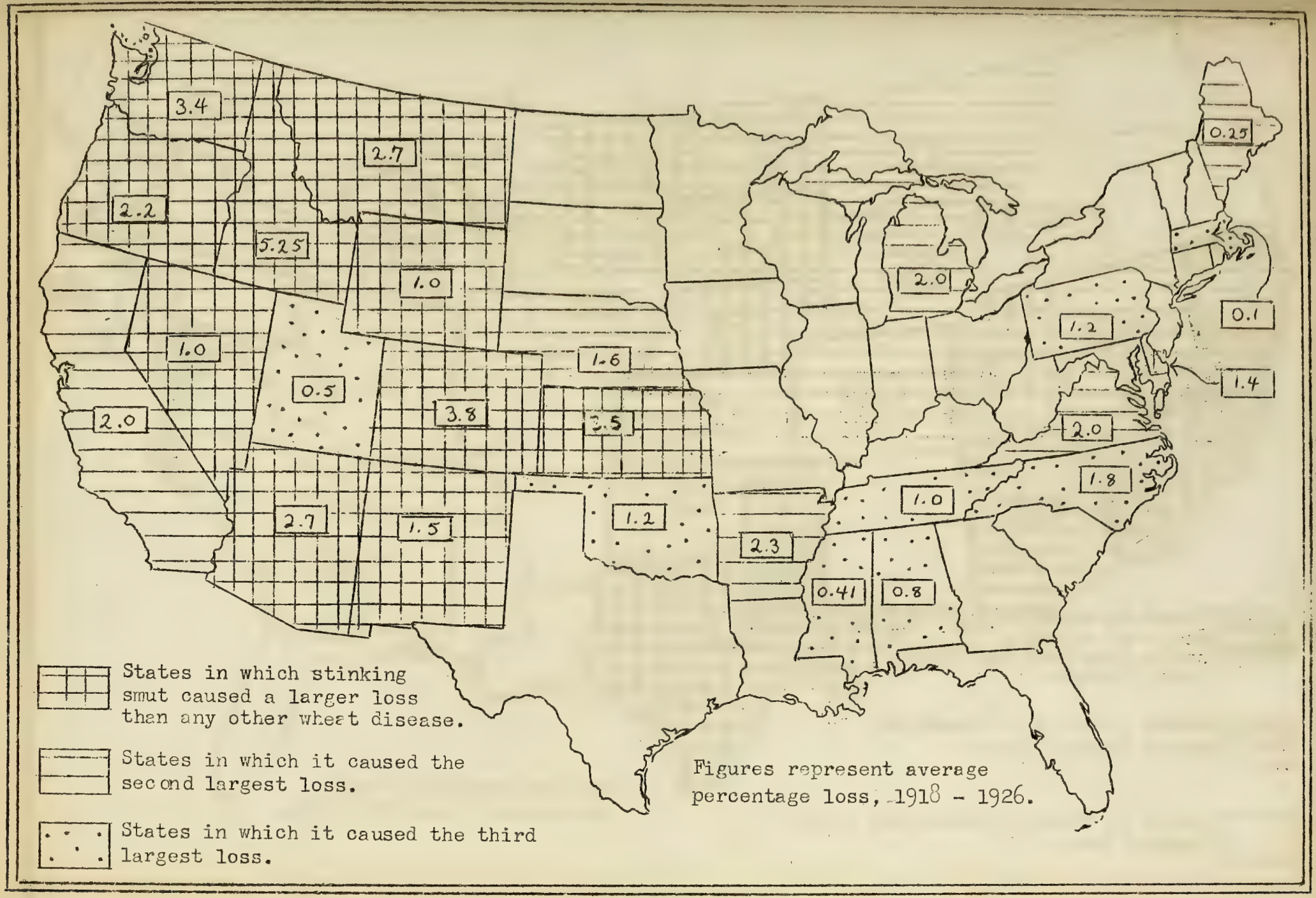

Fig. 4 States in which stinking smut was the most destructive, second most destructive, and third most destructive, of all wheat diseases during 1918 to 1926.

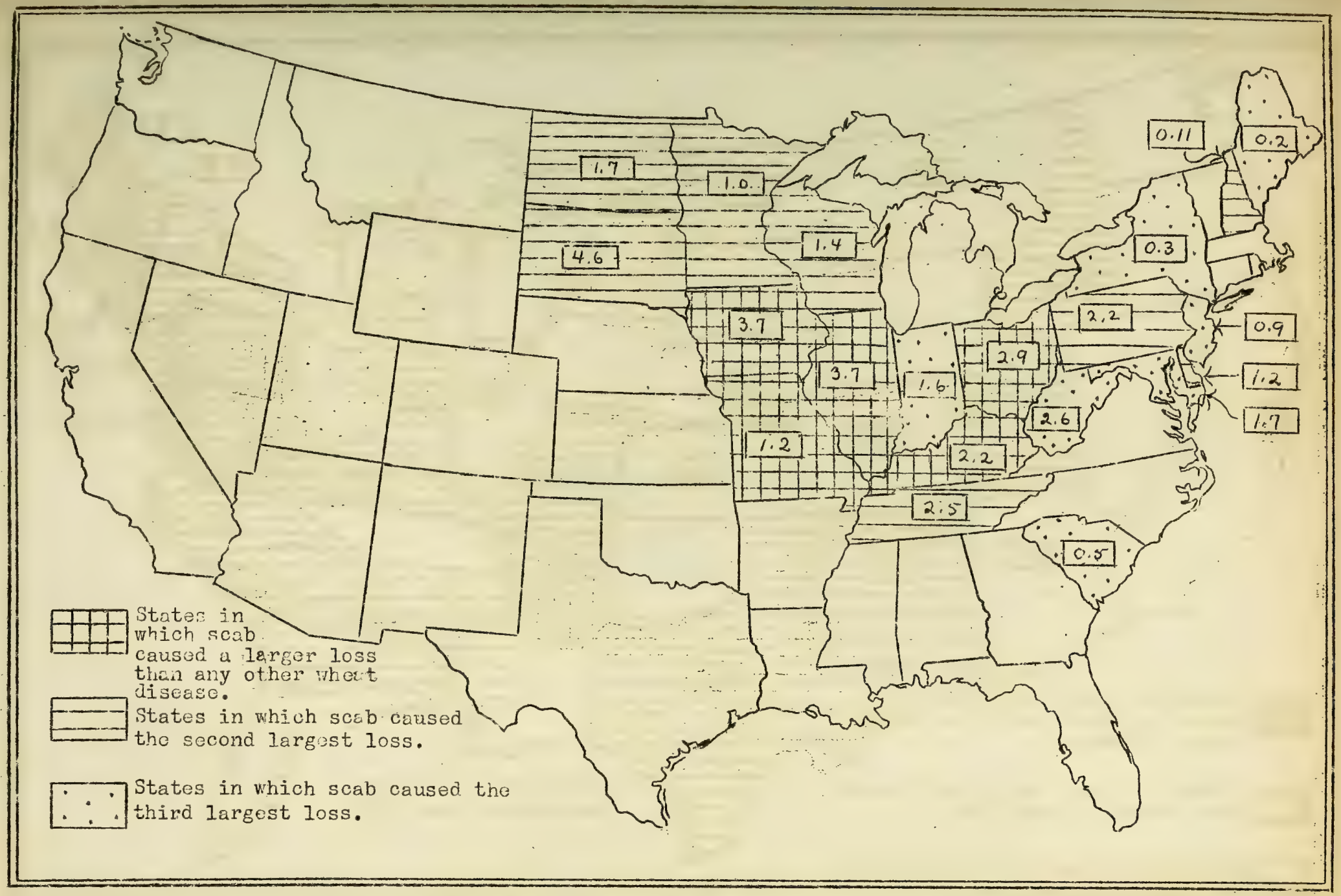

Fig 5 . States in which scab was the most destructive, second most destructive, and third most destructive, of all wheat diseases during 1918 to 1926.

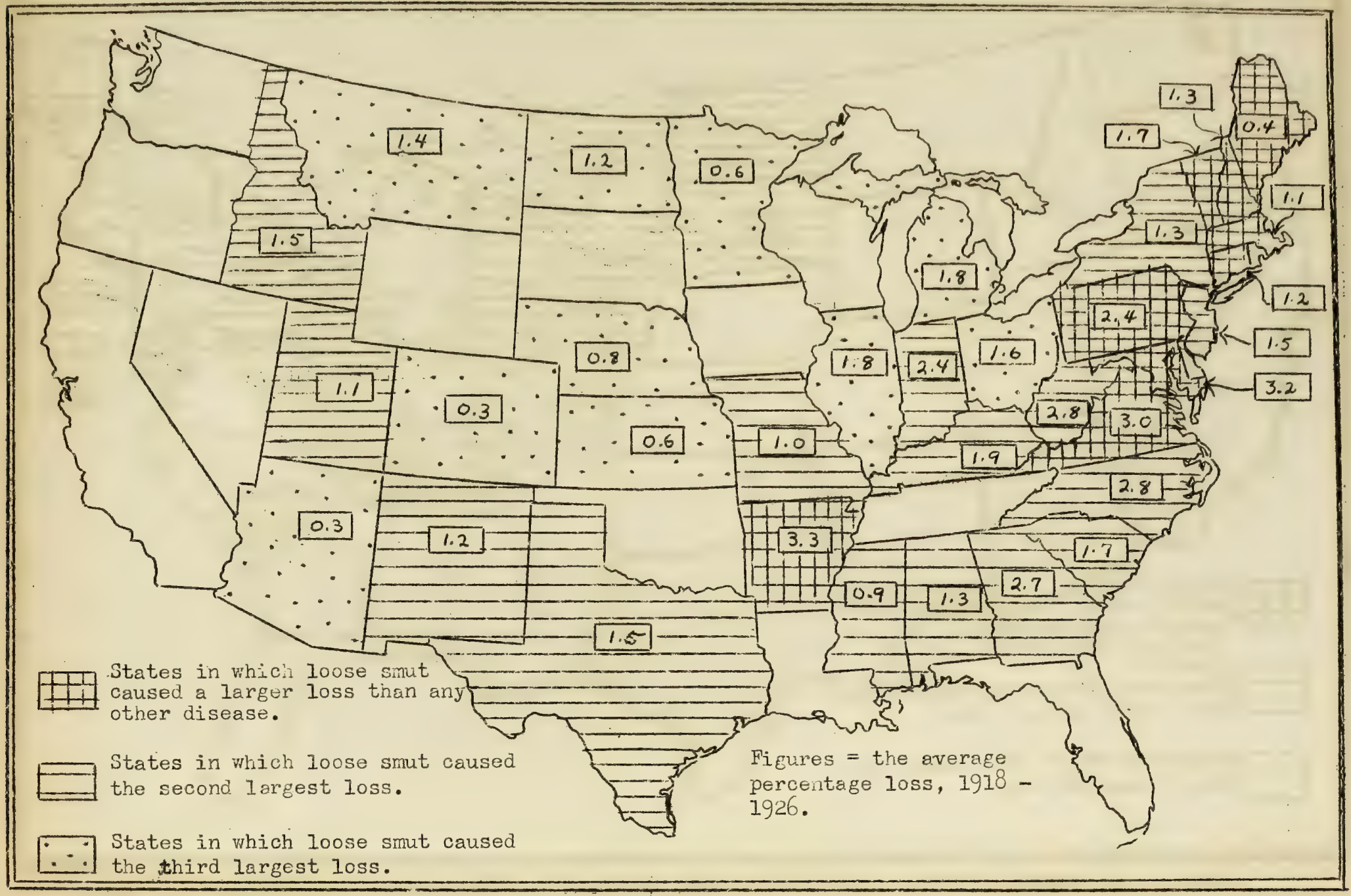

Fig. 6 . States in which loose smut was the most destructive, second most destructive, and third most destructive of all wheat diseases, during 1918 to 1926.

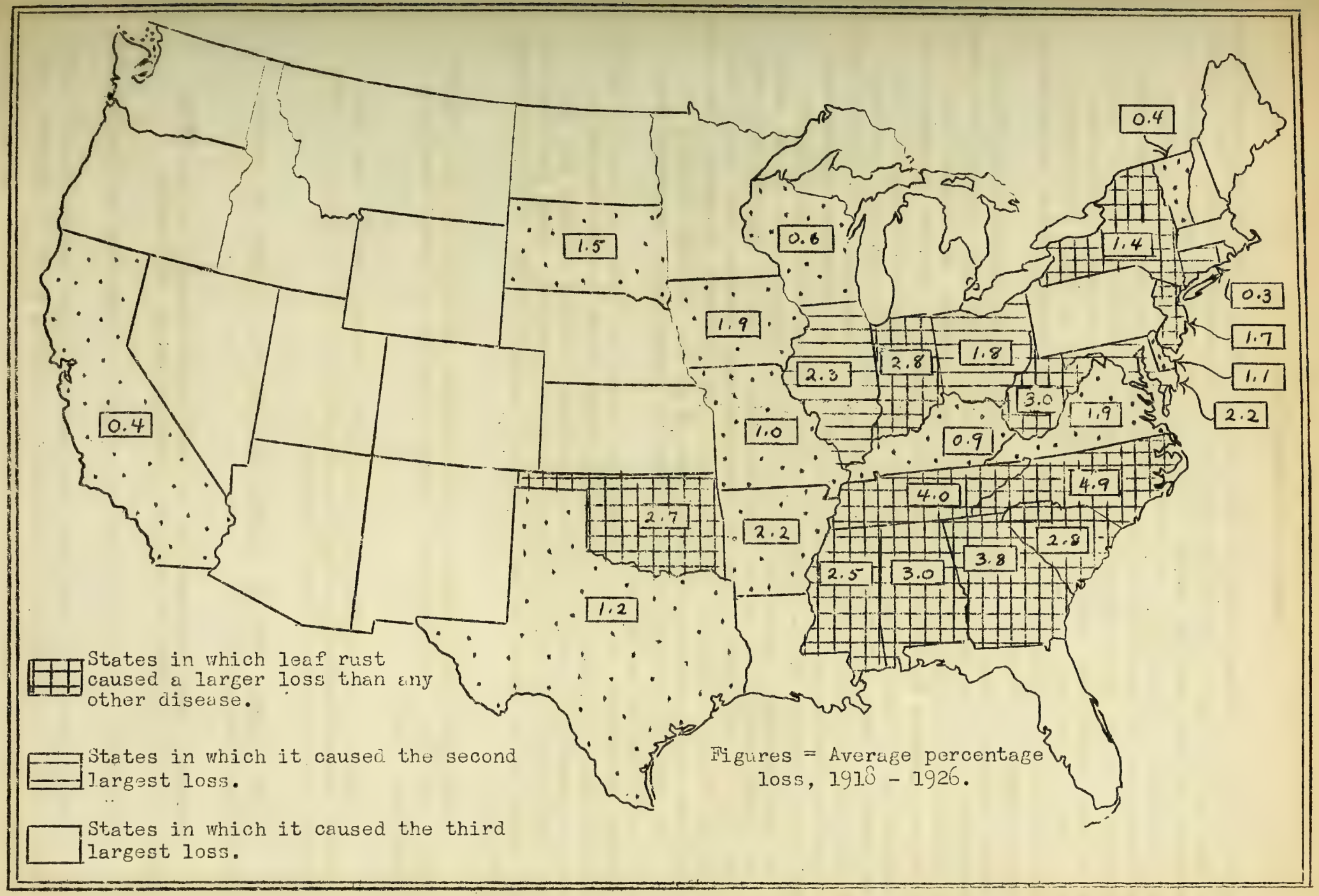

Fig. 7 . States in which leaf rust was the most destructive, second most destructive and third most destructive of all wheat diseases, during 1918 to 1926.

to one-tenth that of smutted heads in the field, or that 80 to 90 per cent of the smutted kernels are removed during harvesting and threshing. Table 29 gives the percentage of cars grading smutty at 15 terminal markets during each of the past four years. These data indicate that during this period smut has been very prevalent in the Central West and the East, and has beenincreasing in some states. F. C. Meier has calculated that of the 22,000 cars of wheat received at the Kansas City market, during August, September, October and November, 1926, 25 per cent graded smutty. Discounts on these cars totaled $272,360, an average of $49.336 for each car grading smutty, which means about 4 1/2 cents a bushel discount.

Tehon obtained records on discounts levied by 207 dealers on 4,796,699 bushels of wheat in Illinois. Smut discounts made on 6.3 per cent of this wheat totaled $22,625.28 or an average of 7.4 cents per bushel. In Missouri similar information was secured by Archer on 3,830,900 bushels. Dealers reported that 30,866 bushels or 0.8 per cent graded smutty and received a discount of 9.1 cents per bushel. These data were compiled for only 18.5 and 12.5 per cent, respectively, of the crops in Missouri and Illinois, therefore, if all the wheat in the two states was as smutty as that reported on, the discount losses would be 5 to 8 times larger. In Pennsylvania, according to Kirby, reports from about 35 of the principal grain dealers in the southeastern part of the state showed that approximately 25 per cent of the wheat offerred them for sale was smutty, but that by refusing to buy the most severely smutted lots and by keeping all smutty wheat in separate bins and cleaning it before shipment, they were able to cut down the percentage of wheat docked at the terminal markets to about 12. The average discount to the grower on smutty wheat purchased was between 10 and 15 cents per bushel.

Weather conditions following sowing of wheat are known to greatly influence smut infection. Little or no infection takes place in soil having a temperature of over 70°F., while soil temperatures ranging between 41° and 59°F. are highly favorable for infection by either species. Late planting was generally given as one cause of the increase of smut in 1926. A few individual reports follow:

North Carolina: Weather bureau records show below normal temperatures and above normal rainfall during November 1925 when wheat was sprouting. (Fant).

Indiana: Wet weather early prevented planting until late when weather became unusually cold, thus checking growth of wheat and permitting development of smut. (Gregory)

North Dakota: Dry at seeding time but cool enough for severe infection. (Brentzel)

Kansas: Smut increase due to cool, moist weather at planting time and the planting of much contaminated wheat. (Melchers)

Colorado: Late plantings more highly infected than early. (Durrell)

Pennsylvania: A very dry late fall kept most farmers from planting wheat until after October 1, when there occurred a period of moist cold weather, especially favorable to smut infection. (Kirby)

Wheat - Stinking Smut

There has been considerable speculation during the past two years as to the reason for the marked increase in smut in the Central and Eastern parts of the United States. Tisdale, Leighty and Boerner (14) have found that it was not due to the introduction of the western form of the smut into these sections. A comparison of the percentage of stinking smut with the date of planting during the period from 1919 to 1926 in Pennsylvania is shown in Figure 10 . According to Kirby, these data indicate that the amount of stinking smut in general increased with later planting but that a sudden delay in the date of planting may not cause a continued general increase for several years. Severe infestation of Hessian fly occurring in 1920 and 1921 caused the radical change in the subsequent dates of planting. The change of planting dates in the fall of 1925 (recorded under 1926) was due to abnormal weather conditions. In sharp contrast to the conditions previously described, which occur in most of the surrounding counties, Union County growers have always planted their wheat early and have almost entirely escaped the smut.

Different groups of common wheat taken as a whole show marked differences in degree of resistance to stinking smut. Comparatively speaking the hard red winter wheats, as a group, are the most resistant, followed by the hard red spring wheats. The soft red winter, the white, and the club wheats, are considered very susceptible. The following data on varietal resistance are taken largely from collaborators' reports during the past five years.

1. Hard Red Winter Wheats.

Resistant:

Ridit. Idaho, Washington. One of most resistant of all common wheats. Its introduction has been a factor in the reduction of smut in the Pacific Northwest.

Hussar. Very resistant in Oregon.

Kanred and Turkey in Kansas, Michigan, Colorado and Pennsylvania, and Kharkof in Kansas and Michigan. Very resistant to T. tritici but only moderately resistant to T. laevis.

Susceptible:

Alton. In the Far West.

2. Soft Red Winter Wheats.

Resistant:

Berkeley Rock. Michigan, Very resistant. This Turkey x Red Rock cross is the outstanding resistant variety in this group.

Fultz in Michigan and Pennsylvania and Pennsylvania 44 in Pennsylvania. These varieties are often fairly heavily smutted and can only be considered as resistant when compared with most of the other soft red winter wheats.

Susceptible:

Fulhio and Trumbull in Pennsylvania. Moderately susceptible but usually having less smut than the following varieties.

Forward and Fulcaster in Pennsylvania, Harvest Queen in Pennsylvania and Kansas. Very susceptible.

Purplestraw. In the Far West. Extremely susceptible.

3. Soft White Winter Wheats.

Resistant:

Martin C. I. 4463. Oregon. This strain of this variety is nearly immune to smut.

Susceptible:

Goldcoin in New York and Pennsylvania. Usually has slightly less smut than Honor and Dawson.

Honor and Dawson in New York and Pennsylvania, Baart and Hard Federation in California, Dicklow in the Far West. All very susceptible varieties.

4. Common Spring Wheats.

Resistant:

Marquis in Minnesota, North Dakota, Colorado. Usually considered as resistant, but under some conditions it has considerable smut. It is apparently the most resistant spring wheat.

Susceptible:

Defiance in Colorado (White Spring Wheat), Kota and Prelude in Minnesota and North Dakota. Susceptible to very susceptible.

5. Durum Wheats.

These wheats as a group are considered quite resistant in Minnesota and North Dakota.

6. Club Wheats.

These are all considered to be very susceptible. Hybrid 128 and Jenkins in Oregon, Little Club in Idaho.

Control:

In practically all states the copper carbonate dust treatment is the one that has been adopted as the standard. In general it has been reported as being very successful. Naturally some difficulties have been encountered such as the following: 1. With very heavily infected seed, copper carbonate dust has been reported as being less efficient than formaldehyde and under some conditions at least it has been found that all smut balls must be removed from the wheat before treating if the smut is to be efficiently controlled. 2. In infested soil, copper carbonate, like blue vitriol reduces but does not eliminate smut infections. 3. Seed treated with copper carbonate dust runs with greater difficulty through most grain drills. This sometimes results in injury to the drill and in the inability of the grower to seed his field properly.

Wheat - Stinking Smut

Table 28 . Percentage loss from stinking smut of wheat, as estimated by collaborators. 1926.

Percentage Loss	States Reporting	Maximum loss in one field	Percentage Loss	States Reporting	Maximum loss in one field
10	Kansas	80	2	Montana	80
8	Colorado	35	2	Washington	
6	Pennsylvania	75	1	South Dakota	
6	Nebraska	80	1	California	48.5
6	Idaho		.75	Oklahoma	
5	Virginia	75	.7	Illinois	1.8
5	Arizona	50	.5	Texas	
4	North Carolina		.5	Ohio	
4	Indiana	25	.5	Minnesota	14
4	Michigan		.5	Iowa	40
3.5	Delaware	33	.2	New York	30
3	Maryland	50	Trace	West Virginia	
3	Oregon		"	Missouri	15
2	North Dakota	50	"	Arkansas	

Table 29 . Percentage of cars grading smutty at terminal markets 1923 - 1926.

Figures compiled by F. C. Meier.

Market	Percentage of all cars received grading smutty 1923	1924	1925	1926
Astoria, Oregon.	52	69	32	57
Portland, Oregon	45	60	30.2	42
Tacoma, Washington	42	54	30	30.5
Los Angeles, California	20	12	15	16
Bozeman, Montana	12	19	15	25
Ogden, Utah	13	21	29	31
Denver, Colorado	21	25	36	25
Oklahoma City, Oklahoma	1	1	-	7
Kansas City, Missouri	8	11	10	25
Omaha, Nebraska	14	26	39	44
Duluth, Minnesota	-	5	17	17
Lawrenceburg, Indiana	6	37	38	40
Toledo, Ohio	1	3	2	5
Philadelphia, Pennsylvania	3	2	10	9
Baltimore, Maryland	.8	2.3	8.5	-

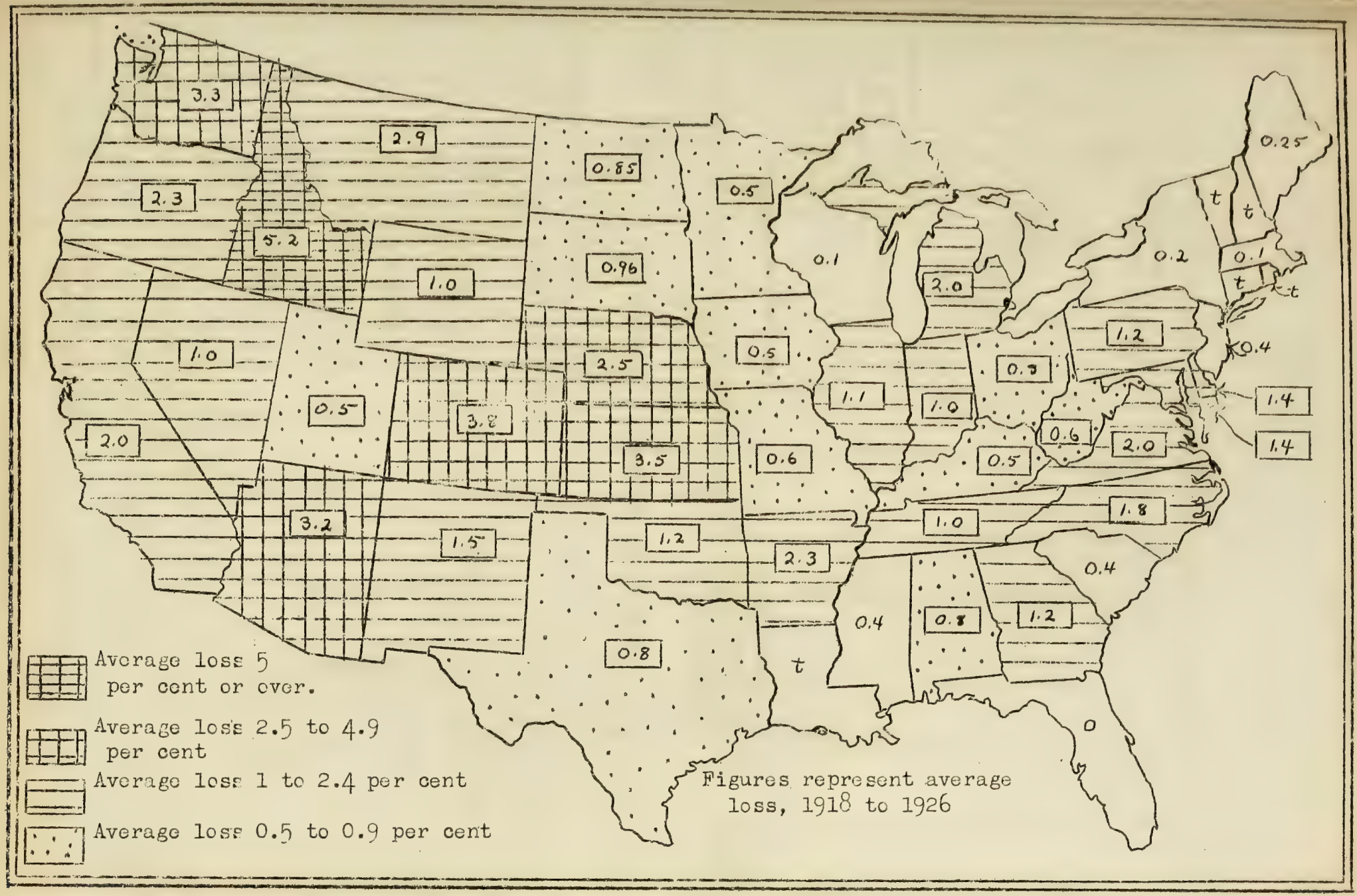

Fig. 8 Average percentage loss from stinking smut of wheat during the period 1918 to 1926.

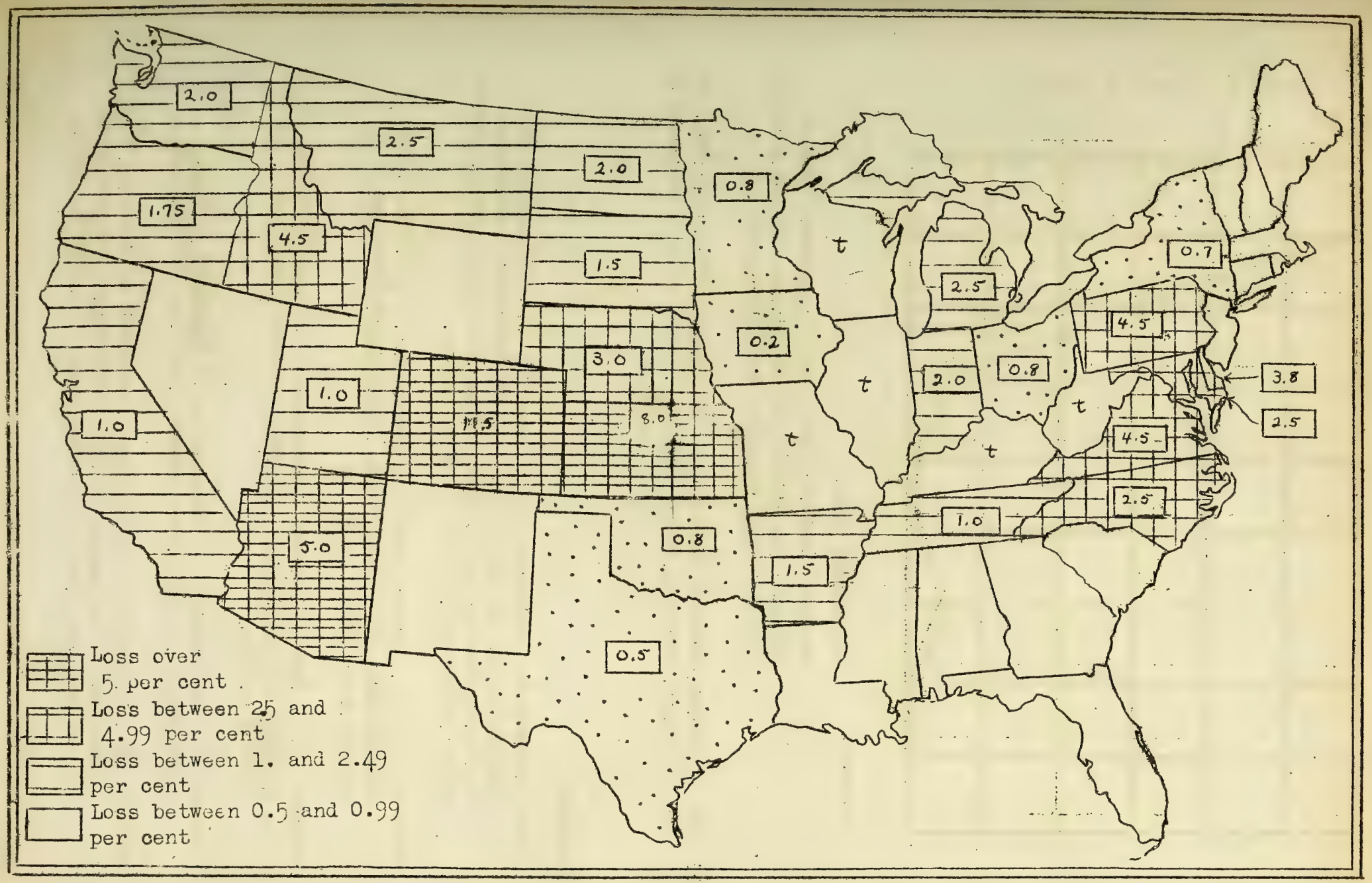

Fig. 9 Average Percentage loss from stinking smut of wheat for 1925 and 1926 as estimated by collaborators.

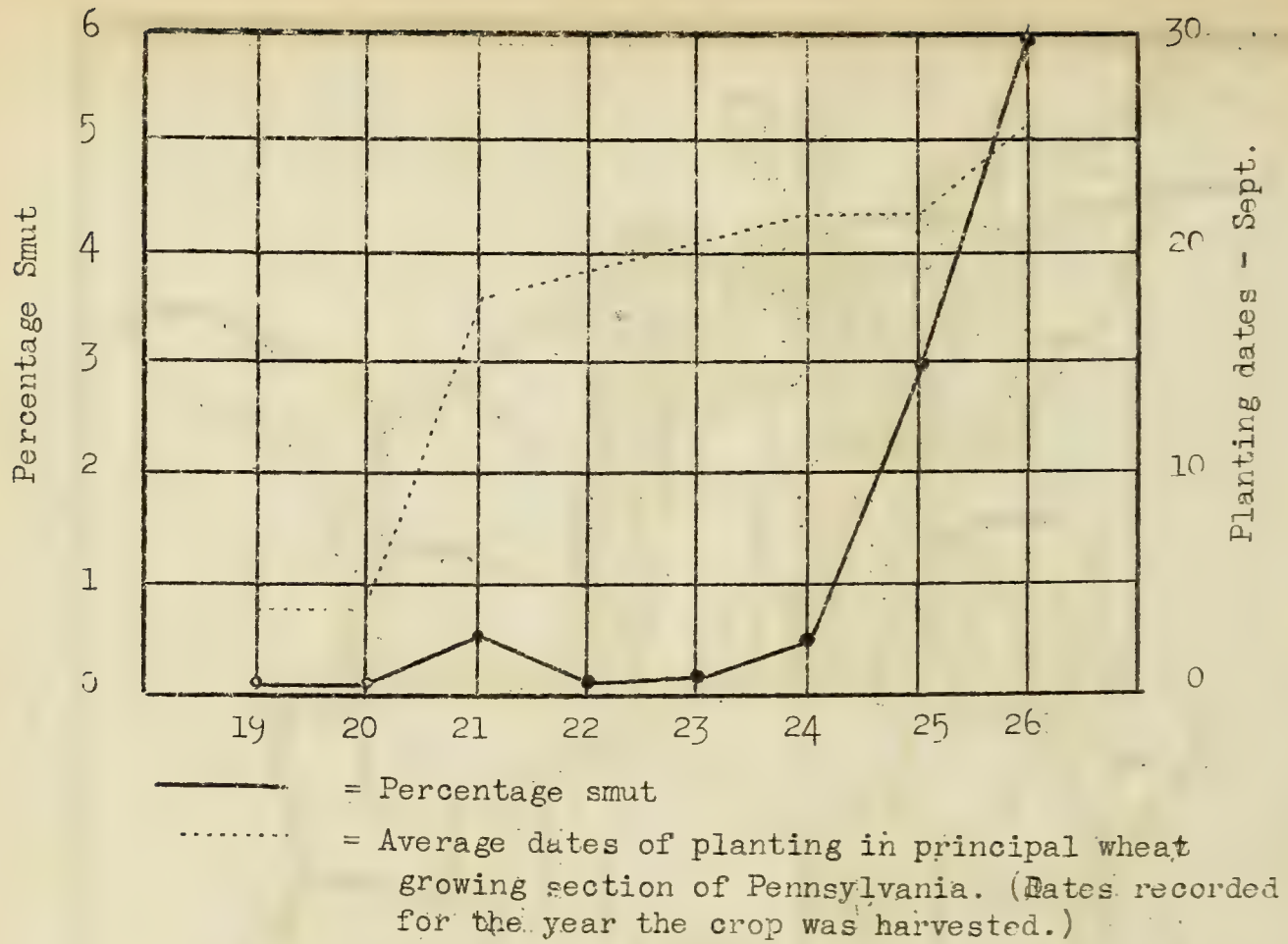

Fig. 10 Relation between Percentage of Stinking Smut and Date of Planting Wheat in Pennsylvania, 1919 - 1926. Prepared by R. S. Kirby.

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LOOSE SMUT CAUSED BY USTILAGO TRITICI (PERS.) ROSTR.

Loose smut has been reported from every state now growing wheat. The loss from this smut seems to have been more constant during the past nine years than that from any other important wheat disease. The average loss has been estimated at 1.11 per cent, and with the exception of 1919 when it was 1.57 per cent, it has not varied over 0.2 per cent from this mean in any year. Loose smut, while rating only fourth in importance among wheat diseases for the country as a whole (see table 30), is nevertheless a most important disease in all regions except the Great Plains and most of the western states. It is most destructive along the Atlantic Coast, where in some states it is the most important wheat disease, and in the Ohio valley. (see figs. 6 and 11.; Losses caused by loose smut 1918-1926) It has also been reported as of

considerable importance during some years in the irrigated regions of certain far western states like Idaho and Utah. It seems to be most prevalent in sections of the country having a high rainfall, and is almost entirely absent in the unirrigated arid regions of the West. Reports from collaborators in 35 states show that in 1926, loose smut was more prevalent in five states and less prevalent in eight than in 1925. Losses reported in 1926 are given in table 30 .

Table 30. Percentage loss from loose smut of wheat, as estimated by collaborators.

Percentage loss	States reporting	Percentage loss	States reporting
3	Maryland, Montana		Texas, Oklahoma, Ohio,
2.8	Virginia (9.1)*		Minnesota, (10), Iowa,
2.5	Michigan (7)		Idaho (7).
2.	Pennsylvania (25), Arkansas, Missouri (20), North Dakota (15), South Dakota (15).	0.5	Illinois, (6), Indiana, Arizona
		Trace	Maine. Delaware, West Virginia, Tennessee,
1.5	New York (10)		Mississippi, Wisconsin,
1	New Jersey, North Carolina, South Carolina,		Kansas (12), Colorado, Oregon, California.

(*) Figures in parentheses represent maximum percentage of smut found in any one field.

In 1926 no variety was reported to be immune.

Resistant Varieties

Spring wheats:

Federation: Very resistant in Idaho.
Haynes Bluestem: Very resistant in Minnesota.
Marquis: Very resistant in Minnesota.

Winter wheats:

Soft white varieties:

Goldcoin (Junior No. 6): Very resistant in New York and Pennsylvania.

Soft red varieties:

Fulcaster: Strains of this variety have been reported in Virginia and Missouri as resistant.
Fultz: Quite resistant in Pennsylvania.
Leap: Most resistant soft red variety in New York, Pennsylvania, and Virginia.

Hard red varieties:

These varieties (Kanred, etc.) in Kansas in 15 years observation never showed over 2 per cent, and in

commercial fields the average is about 0.25 per cent, as compared with 3 to 10 per cent in soft varieties. -- Melchers.

Susceptible Varieties

Spring wheats:

Defiance: Very susceptible in Colorado.
Dicklow: Susceptible in Idaho.
Kota: Susceptible in Minnesota and North Dakota.

Winter wheats:

Soft white varieties:

Dawson, Honor: Reported as susceptible or very susceptible in New York and Pennsylvania.

Soft red varieties:

These varieties (Harvest Queen, etc.)"in Kansas often show 12 to 20 per cent infection."
Fulcaster: Strains of this variety growing in New York and Pennsylvania are susceptible.
Pennsylvania 44: Moderately susceptible in Pennsylvania.
Pocle: Very susceptible in Missouri.
Red Rock: Very susceptible in New York and Pennsylvania.

"The control measures recommended in Colorado are the securing of seed from fields as free as possible from smut." (L. W. Durrell). In Pennsylvania the control measures consist of "establishing 3 to 5 disease-free seed source farms for each susceptible wheat variety, i. e., Pennsylvania 44 and Red Rock. On each of these farms a college pathologist supervises the treating of all the seed wheat, by a combined hot water organic mercury method. Wheat grown from this treated seed is then distributed to numerous farms. Such seed one generation from treatment has been found to produce wheat crops which in nearly all cases are entirely free of smut." (Kirby). In Virginia hot water treatment was used. "A survey of 57 fields from hot water treated seed averages 0.3 per cent smut as compared to an average of 2.8 per cent infection in the whole state." (Fromme and Godkin).

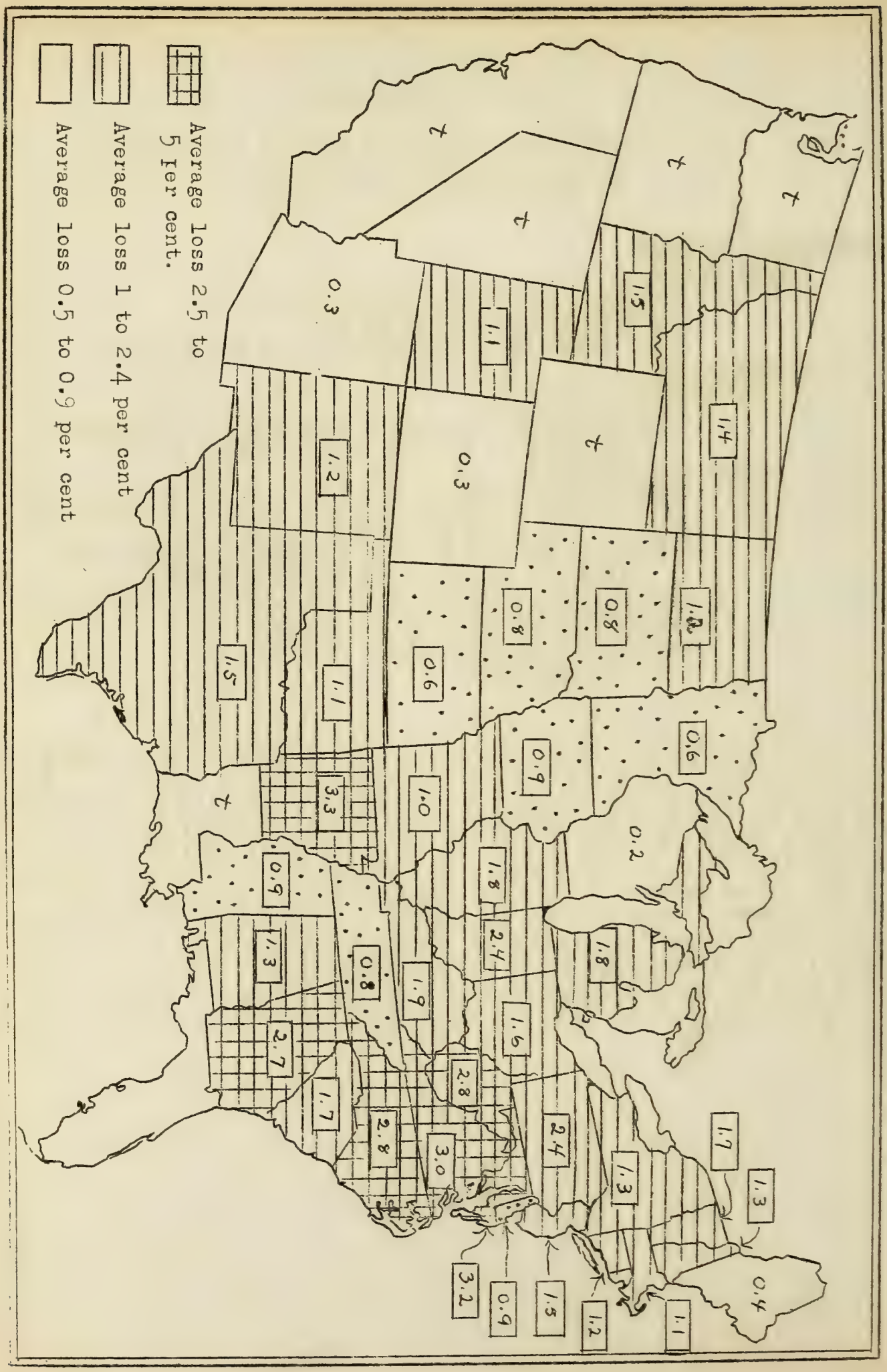

Fig. 11. Average percentage loss caused by loose smut of wheat from 1918 to 1926.

Recent literature:

1. Brentzel, W. E. Loose smut of wheat. North Dakota Agr. Exp. Sta. Circ. 29: 3-11. 1926.

2. Fromme, F. D. Susceptibility of wheat varieties and selections to loose smut. (Abstract) Phytopath. 16: 86-87. 1926.

3. Kirste, A. Erfahrungen mit Heisswasserbeize in der landwirtschaftlichen Praxis. Pflanzenbau 2: 272-273. 1926.

4. Petri, L. Concentrazione degli ioni di H e azione del calore sulla germinabilita delle spore di Ustilago tritici. Boll. R. Staz. Patol. Veg. Rome. n. s. 6: 251-252. July, 1926.

5. Tamm, E. and B. Husfeld. Die elektrische Heisswasserbeize, ein neuer Weg zur technischen Durchfuhrung des Heisswasserverfahrens. Pflanzenbau 2: 197-202, 213-220. 1926.

6. Tapke, V. F. Single-bath hot-water and steam treatments of seed wheat for the control of loose smut. U. S. Dept. Agr. Bul. 1383: 1-29. 1926.

7. Tisdale, W. H. Recent progress in the control of cereal smuts. (Abstract) Phytopath. 16: 645-646. Sept. 1926.

FLAG SMUT CAUSED BY UROCYSTIS TRITICI KOERN.

What was thought to be the first collection of this smut in the United States was made by J. G. Dickson and others, May 5, 1919, in Madison County, Illinois. However, during 1926 the Plant Disease Survey received through W. H. Tisdale a specimen collected by S. M. Zeller, one year earlier, May 11, 1918, in St. Louis County, Missouri. The specimen had been labeled Urocystis sp. and was not determined as Urocystis tritici by Tisdale until 1924.

Flag smut is known to occur only in three states, Illinois, Kansas, and Missouri. Brief reports from two of these are given below:

Missouri - Flag smut is reported to be rather common each year in the bottom lands of St. Charles County. (W. A. Archer).

Illinois - P. A. Glenn of the Illinois State Department of Agriculture reports:- "Surveys were made in each of the nine counties in which flag smut has been reported and in Perry and Randolph Counties. The survey included about 1100 fields and 7 were found to be infested. The infestations in these 7 fields were all very slight. Results of the survey are shown in table 31.

Table 31 . Survey for flag smut of wheat in Illinois, 1926.

County	No. Fields inspected	No. Fields infested	Acres of Resistant wheat
Greene	125	None	
Jersey	Not stated	"	225
Lincoln	80	"	
Macoupin	95	"	
Madison	200	4	565
Monroe	84	1	500
Perry	22	None	
Randolph	60	"	
Scott	33	"	
St. Clair	230	2	500
Washington	131	None	
	1,060	7	

Tisdale (1) reports that Shepherd, Mammoth Red and Trumbull are resistant to flag smut.

Recent literature:

1. Tisdale, W. H. Recent progress in the control of cereal smuts. (Abstract) Phytopath. 16: 645-646. Sept. 1926.

STEM RUST CAUSED BY PUCCINIA GRAMINIS PERS.

Stem rust occurs practically everywhere wheat is grown in this country. The loss data presented in Fig. 12 indicate that during the last nine years it has caused greatest loss in the spring wheat states and Wisconsin, and has been very destructive in Texas, California, and most of the middle western states.

In the United States during the past eight years stem rust probably caused a loss more than twice as large as that due to any other wheat disease and it has been estimated to be responsible for 37.5 per cent of the total loss caused by all wheat diseases in Minnesota and Wisconsin. Since 1919, however, its importance has, in general, been decreasing. This fact is well brought out in the accompanying graph (fig. 13), prepared from collaborators' annual estimates of crop losses since 1918, which shows also that most of the decrease has occurred in the barberry eradication area, losses in the other states having remained more or less constant during the entire period.

In 1926 several other wheat diseases were responsible for a greater total loss than stem rust. Losses from stem rust were much below normal, in fact the damage was probably less than has occurred during any year since 1918. Table 32 gives estimates of losses for the year as reported by collaborators.

Concerning the 1926 rust situation, Kempton and Hutton report as follows: (Cereal Courier 18: 186, July, 1926.)

> "Stem rust did very little damage in Texas, Oklahoma, Kansas, Missouri, and Nebraska. While wheat was not harvested in late June in South Dakota and southern Minnesota, it did not seem that the rust could do very much damage except locally.
>
> "Stem rust is much later in most places than it was last year. The weather in most places has not been so favorable for the development of rust as it was last year. This much is certain, however: Wherever there are barberry bushes stem rust is exceptionally heavy."

In Minnesota the Department of Plant Pathology reports that stem rust was general throughout the state, infection ranging from 30 to 70 per cent. The amount of rust varied greatly in different fields and different sections. The rust came late and did little damage. In California, J. A. Clark reported that a real North Dakota epidemic of stem rust occurred, completely destroying much of the wheat in the southern part of the state.

To assist observers in estimating losses from stem rust when attacking the host at different stages, the Office of Cereal Crops and Diseases has worked out the following convenient table.

Table 32 . Table for computing loss from stem rust.

Stage of development of the crop						Loss from stem rust
Boot	Flower	Milk	Soft dough	Hard dough	Mature	
Percentage of stem rust-average severity in field (According to scale for estimating rust)						Per Cent
-	-	-	-	(tr)	5	0.0
-	-	-	(tr)	(5)	10	0.5
-	-	(tr)	(5)	(10)	25	5.
-	(tr)	(5)	(10)	(25)	40	15.
(tr)	(5)	(10)	(25)	(40)	65	50.
(5)	(10)	(25)	(40)	(65)	100	75.
(10)	(25)	(40)	(65)	100	100	100.

Epidemiology

Stem rust was reported by Kempton and Hutton (Cereal Courier 18: 186, July 31, 1926) as overwintering in the uredinial stage on wheat in both southern and northeastern Texas. It apparently also overwintered in Sonora, Mexico, where A. W. Morrill reports that stem rust caused great damage to wheat during February and March. Reports indicate that stem rust infection became general in California and Arizona during April and May and that it was found during May in Arkansas, and during the first half of June in all the Mississippi Valley states to the Canadian line; further that barberry

infection appeared in Missouri, Iowa, South Dakota, and Minnesota three to four weeks before the uredinial stage of stem rust was observed on wheat in those states.

In connection with the important relationship between barberry infection and the resulting loss from stem rust in wheat, it has been pointed out by several reporters that the small amount of stem rust in 1926 was partly attributable to exceptionally late appearance of the rust on the barberry bushes and its abnormally late spread to the wheat. Dry weather was reported from several states as causing this late barberry infection, and L. W. Melander (Cereal Courier 18: 111. 1926) states that extremely dry weather prevented teliospore germination.

Stem rust, as usual, was reported from the barberry eradication area and certain surrounding states, Colorado, Ohio, Pennsylvania, South Dakota, as first coming from infected barberry bushes. In Colorado, Missouri, Ohio, Pennsylvania, and Virginia, it was too late on wheat to do much damage. Data on first observation of stem rust infection are given in table 34.

Weather relationships

The relation between dry weather and barberry infection has already been mentioned. The amount of rainfall during the month preceding wheat harvest greatly influenced the amount of stem rust damage. In California, where much of the wheat crop was destroyed by rust, April, 1926, is recorded as the wettest (rainfall 3.48 in. above normal) and warmest April on record during the thirty years of keeping weather records. Very heavy rust losses were reported from Arizona, where much the same conditions prevailed as in California (April rainfall 2.25 in. above normal.) In the middle western states, with only two exceptions, Illinois and Michigan, the loss from stem rust was below the average. The rainfall during June throughout that section was far below the average, with only Illinois and Michigan having a definite excess.

Varietal Susceptibility

In the following reports it must be taken into account that the susceptibility of any variety of wheat may vary in different sections, or even in the same section from year to year, because of the many biologic forms of stem rust which are scattered throughout the country.

Varieties immune

Acme, Indiana
Buford, Indiana
Einkorn, Indiana
Kubanka strain, Indiana
Mindum, Indiana
Vernal (emmer) Indiana

Varieties very resistant

Kota, Minnesota
Peliss (Webster), Indiana.

Varieties resistant

Defiance, California, Mexico[1]
Early Defiance, California

Wheat - Stem Rust

Varieties resistant (Cont'd)

Ervan, California[2]
Huron, Indiana
Kanred, Kansas[3]
Kota, North Dakota,
California.
Marquis, California[4]
Norka, Indiana
White Federation,
California[5]

Pacific Bluestem,
Colorado
Quality, North Dakota
Resaca, Indiana
Ruby, North Dakota
Turkey Red, Colorado

Varieties susceptible

Agini, Indiana
Illinois #1, Indiana.
Marquis, North Dakota,
Indiana, Colorado.

Varieties very susceptible

Marquis, Minnesota
Preston, Minnesota
Ruby, Minnesota
White Spring Spelt,
Indiana

Notes: All reports from Indiana by E. B. Mains, from Colorado by L. W. Durrell, from Minnesota by the Section of Plant Pathology, from Kansas by L. E. Melchers, from North Dakota by W. E. Brentzel.

1. In the Yaqui Valley of Sonora, Mexico, A. W. Morrill reports that this variety stands up best under epidemic conditions.

2. One of the most resistant. -- W. W. Mackie
Some of the selections in Prof. Mackie's nursery proved very resistant, the most resistant coming from Early Defiance crosses. Pusa No. 4 also transmits resistance in hybrids in a satisfactory degree. The classification nursery grown by Mr. Florell was nearly destroyed by rust, Kota, Kanred, and Erivan having less than 5 per cent infection. Most of the earlier Australian and Indian varieties also escaped rust. -- J. A. Clark, Cereal Courier 18:142. June, 1926.

3. Most resistant hard red variety. -- L. E. Melchers.

4. Was one of most resistant. -- J. A. Clark.

5. One of most resistant varieties. -- W. W. Mackie

Clark, Martin, and Stakman (4) reported in a report on the results of cooperative experiments conducted at 39 places in the United States and Canada, that the durum wheats were much more resistant as a class than the hard red spring wheats. The varieties Pentad, Monad, Acme, and Nodak were the most resistant. Of the hard red spring wheats, Kota and a few hybrid wheats were much more resistant than Marquis, and Marquis escaped rust slightly better than Power, Preston, and Haynes Bluestem. Except for the resistant varieties, the average rust infection on the common wheats increased with the lateness of the average date of maturity of the varieties. Early varieties evaded rust better than Marquis. Two varieties of spring emmer that were tested were nearly immune to rust.

Table 33 . Estimated percentage loss from stem rust of wheat, as estimated by collaborators, 1926.

Percentage loss	States reporting	Percentage loss	States reporting
8	Arizona	.1	New York, Pennsylvania
5	Minnesota		Virginia, Montana.
3.5	Michigan	Trace	Massachusetts, Maryland,
3.	Wisconsin		West Virginia, North
1.75	North Dakota		Carolina, Arkansas,
1.24	South Dakota		Missouri, Nebraska,
1.	Illinois, Iowa		Kansas, Wyoming,
.75	Texas, Oklahoma		Colorado, Idaho,
.5	Ohio, Indiana, California		Washington, Oregon.

Table 34 . Dates and places of first observation of stem rust on barberry and wheat in 1926.

Date	Place	County	State
On Barberry Bushes:			
May 3	Marion	Cole	Missouri
May 3	Dayton	Montgomery	Ohio
May 5	Jefferson	Greene	Iowa
May 5	Marion Township	Olmsted	Minnesota
May 15	---------	Brookings	South Dakota
June 1	Warren	Warren	Pennsylvania
June 5	---------	------	North Dakota
On Wheat			
February	Severe infestation	Yaqui Valley,	Sonora, Mexico.
April	" "	Davis	California
May	" "	Salt River Valley	Arizona
May 30	Fayetteville	Washington	Arkansas
June 7	Columbus	Cherokee	Kansas
June 9	Wells	Faribault	Minnesota
June 10	North Platte	Lincoln	Nebraska
June 11	Grayville	White	Illinois
June 11	---------	---------	South Dakota
June 11	Fargo	Cass	North Dakota
June 16	Marshall	Madison	North Carolina
June 18	St. Louis	St. Louis	Missouri
June 24	North Freeman	Sauk	Wisconsin
June 24	Shippensburg	Cumberland	Pennsylvania
July 1	Grand Traverse	---------	Michigan
July 10	Montrose	Montrose	Colorado

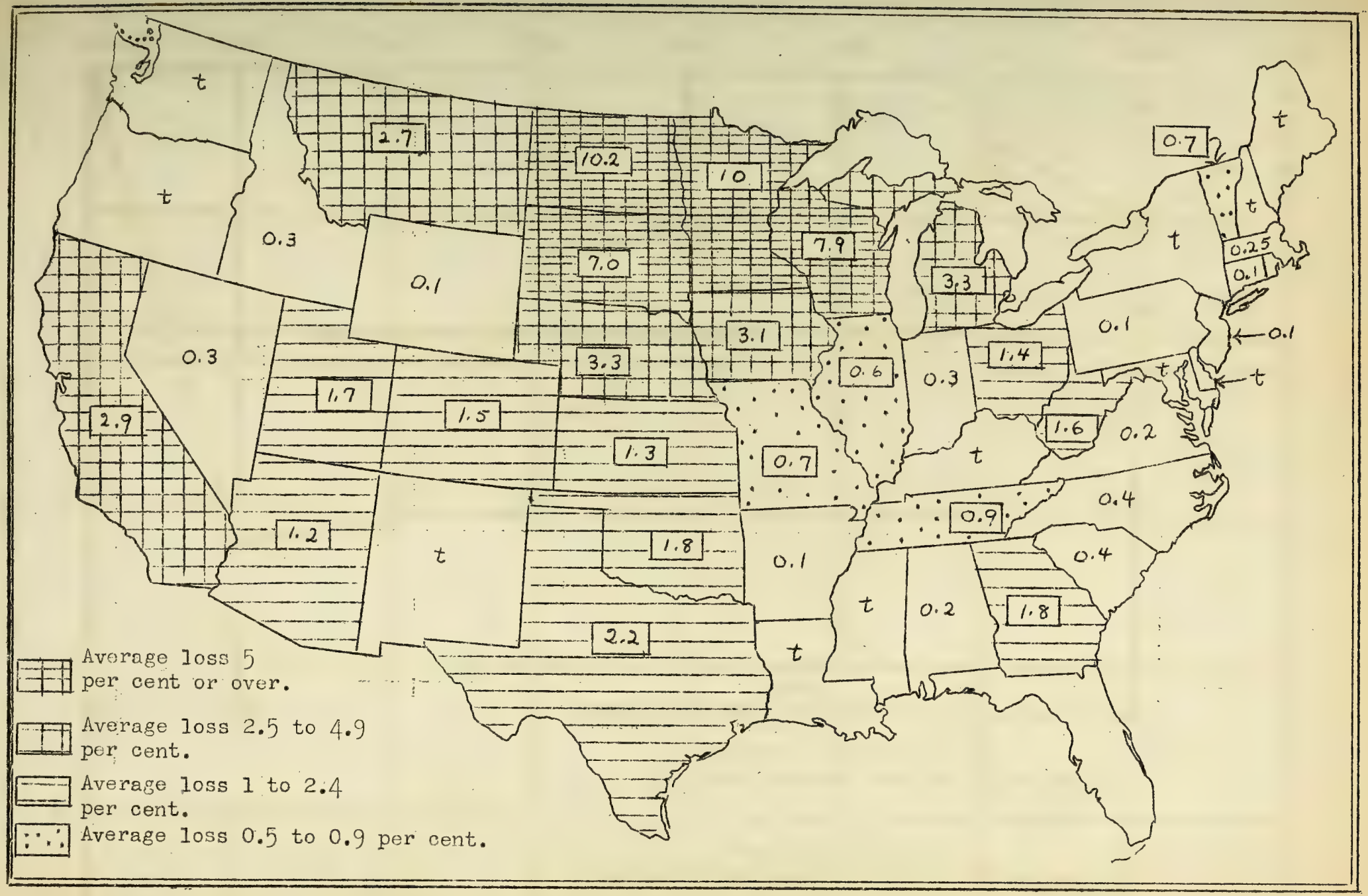

Fig. 12 . Average percentage loss caused by stem rust of wheat from 1918 to 1926.

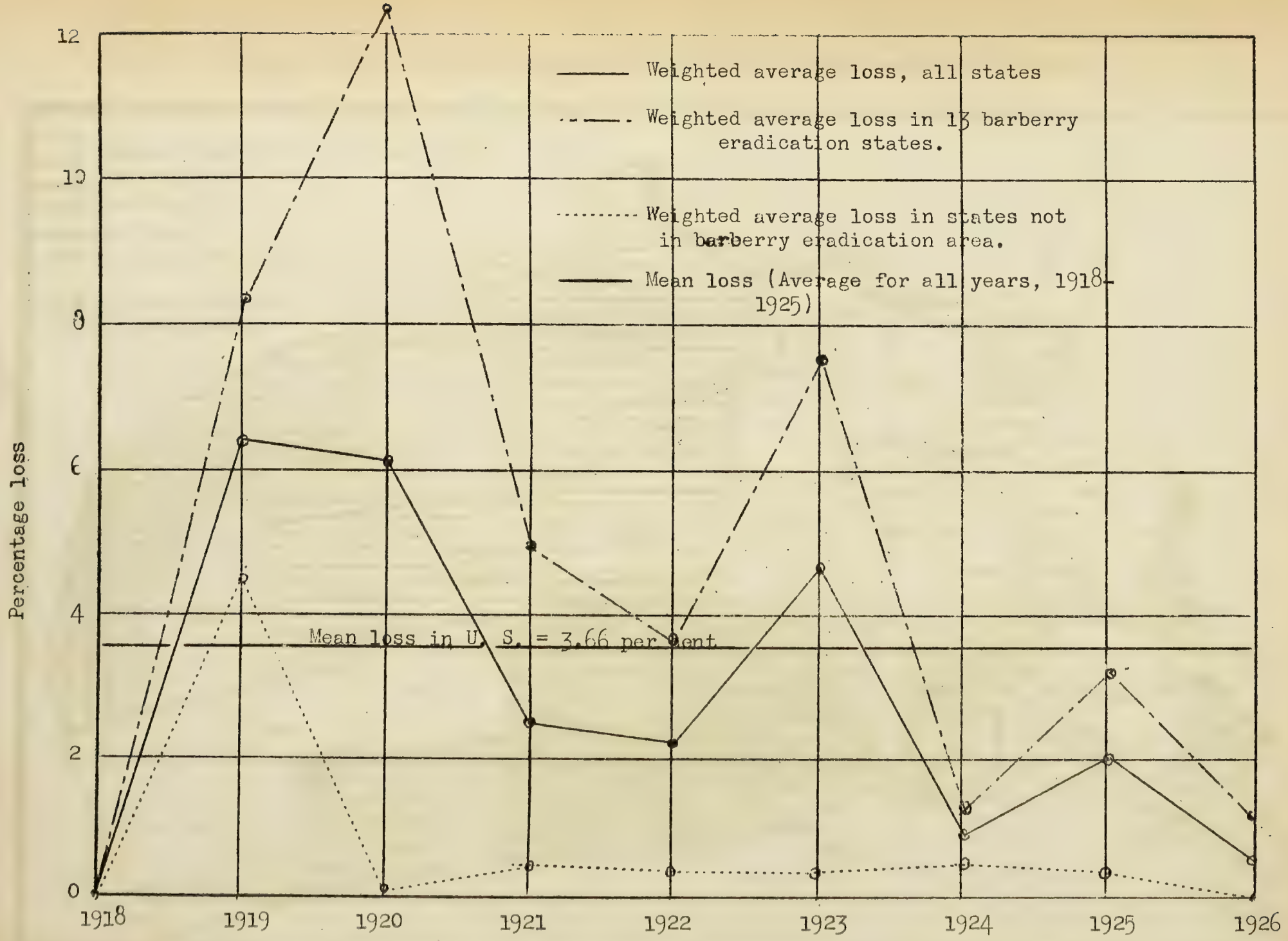

Fig. 13 Estimated percentage loss of wheat from stem rust from 1918 to 1926.

Wheat - Stem Rust

Recent literature:

1. Allen, R. F. Cytological studies of Forms 9, 21 and 27 of Puccinia graminis tritici on Khapli emmer. Jour. Agr. Res. 32: 701-725. 1926.

2. Bailey, D. L. and F. J. Greaney. Field experiments on the control of stem rust by sulphur dust. Sci. Agr. 7: 153-156. Jan. 1927.
Stem rust was a negligible factor in Manitoba this year due apparently to unfavorable environmental conditions and to scarcity of inoculum.

3. Bulger, R. O. Stem rust and the common barberry in South Dakota. South Dakota State Col. Agr. Ext. Div. Circ. 240: 1-23. 1926.

4. Clark, J. A., J. H. Martin, and E. C. Stakman. Relative susceptibility of spring-wheat varieties to stem rust. U. S. Dept. Agr. Circ. 365: 1-18. 1926.

5. Curran, G. C. and B. Koehler. Protection of grain crop demands barberry eradication. Illinois Agr. Exp. Sta. Circ. 308: 1-12. 1926.

6. Durrell, L. W. and E. A. Lungren. Berberis fendleri, an alternate host of Puccinia graminis tritici. Phytopath. 16: 234-235. 1926.

7. Gonzales Fragoso, R. Las 'royas' des los cereales. Bol. Estac. Pat. Veg. 1: 41-48, 1926.

8. Henning, E. Annu Nagra ord om mojligheterna for en rationell utrotning av Berberisbusken. (A few more observations on the possibilities of a rational system of eradication of barberry bushes.) Landtmannen, 9: 472-473, 1926.

9. Hynes, H. J. Studies on the reaction to stem rust in a cross between Federation wheat and Khapli emmer, with notes on the fertility of the hybrid types. Phytopath. 16: 809-827. Nov. 1926.

10. Lindfors, T. Berberisutrotningen i Sverige. (Barberry eradication in Sweden.) Landtmannen 9: 412-413. 1926.

11. Maxwell, I. and G. B. Wallace. Black rust in Scotland. Trans. Brit. Mycol. Soc. 11: 138-145. 1926.

12. Newton, Margaret and Thorvaldur Johnson. Greenhouse experiments on the relative susceptibility of spring wheat varieties to seven physiologic forms of wheat stem rust. Sci. Agr. 7: 161-165. Jan. 1927.

13. Newton, Margaret and Thorvaldur Johnson. Physiologic forms of wheat stem rust in western Canada. Sci. Agr. 7: 158-161. Jan. 1927.

14. Reddy, W. F. Black stem rust situation in Michigan. Michigan Agr. Exp. Sta. Quart. Bull. 8: 148-151. Feb. 1926.

15. Stakman, E. C. The wheat rust problem in the United States. Proc. Pan-Pacific Sci. Congr. 1923, 1: 88-96. 1924.

16. Stakman, E. C. Methods of reducing losses from black stem rust of wheat. Proc. Pan-Pacific Sci. Congr. 1923, 1: 132-136. 1924.

17. Stakman, E. C. Present status of the black stem rust situation. Northwestern Miller 145: 476. Feb. 3, 1926.

LEAF RUST CAUSED BY PUCCINIA TRITICINA ERIKS.

This major wheat disease has been reported from practically every state. It is very destructive in the southeastern part of the country where the spring rainfall is usually heavy, moderately important in most of the states east of the Rocky Mountains, and practically negligible in the dry sections of the western states. See Fig. 14.

In 1926 it apparently caused a slightly larger loss than in 1925. Losses reported are given in Table 35. It was unusually severe in California and Arizona. Concerning its occurrence in the southwestern part of the country, C. O. Johnston, (Cereal Courier 18: 159, 1926) states that:

> "The spring of 1926 was one of extremes in leaf-rust infection. An extremely heavy infection occurred in nursery seedings at Denton, Texas. Northern Texas and southern Oklahoma experienced generally heavy infections. The amount of rust gradually diminished to the northward. Northern Oklahoma and southern Kansas had a moderate amount of leaf rust early in the season, but very dry weather ripened the wheat early and prevented any material increase. Eastern, northern and northwestern Kansas had very light infections of leaf rust, which came in very late. Central Kansas had a moderate amount of rust, which came in very late but increased rapidly until hot dry weather ripened the wheat."

Concerning the southeastern and eastern parts of the United States, E. B. Mains states:

> "The dry spring again held leaf rust of wheat in check. At Tifton, Georgia, Prof. R. P. Bledsoe report on May 20 that many of the varieties in the wheat nursery were dried up making notes on varietal differences very difficult. Susceptible varieties at that time, however, showed a fairly heavy infection. At Experiment,

Georgia, leaf rust developed only to a slight extent on account of the dry weather. Dry weather also interfered with leaf rust development at Knoxville, Tennessee. On June 14, however, susceptible varieties on low ground were moderately rusted. On higher ground very little leaf rust was evident and wheat was ripening. At Marshall, North Carolina, June 15, leaf rust was fairly abundant on susceptible varieties in a wheat nursery in a creek bottom. At Swannanoa, North Carolina, only a scattering of leaf rust was found on high ground. Prof. Lehman later reported a moderate infection on wheat in low spots. On the Arlington Farm, Washington, D. C., June 17, I was unable to find leaf rust except on one or two low spots.

"At La Fayette, Indiana, there was a slight amount of overwintering of leaf rust. Although we had plenty of rain the rust developed slowly, possibly due to cool weather. By June 22 the most susceptible varieties showed a moderate infection. By July 6, a few days before harvesting, these were fairly heavily infected. On spring wheat, which was planted very late on account of difficulty in preparing the ground, leaf rust had a good opportunity to develop. By July 8, susceptible varieties were 100 per cent rusted, and harvesting did not start until July 23.

"At Madison, Wisconsin, Dr. Dickson informed me that leaf rust also developed very slowly this spring. On July 19, winter wheats were starting to ripen. At that time susceptible varieties were fairly heavily rusted. Spring wheats at that time were still green and susceptible varieties showed 100 per cent leaf rust."

In Indiana, Iowa, and Michigan, leaf rust was said to be more prevalent and destructive than for several years.

At La Fayette, Indiana, E. B. Mains reported that, "A slight amount of overwintering of leaf rust occurred," and R. E. Vaughan stated that in Wisconsin, "Leaf rust is present throughout the whole year." The rust became general in April in California, in May as far north as Kentucky and Delaware, and during the first half of June as far north as the Dakotas.

Regarding injury to wheat by leaf rust, E. B. Mains (2) states:

"Leaf rust often has been considered as causing little or no loss in production. By a comparison of a number of series of rusted plants with rust-free plants in the greenhouse from 1922 to 1925, it has been found that under some conditions there is a considerable reduction in the seed developed by rusted plants. The extent of the reduction depends on the severity of the infection, the infection period, and varietal susceptibility. When susceptible varieties are heavily infected from the seedling state to maturity, little or no seed is produced. Severe infection from the beginning of heading to maturity has produced 15 to 25 per cent reduction in seed formation. It was found that the upper and lower spikelets in the heads of rusted plants usually failed to develop seed. The middle spikelets produced fewer seeds due to the failure of the development of the central flowers. Blossoming starts in the outer flowers of the spikelets and the

middle spikelets of the head, progressing inwardly in the spikelet and up and down the head. While the first flowers to blossom in rusted plants are able to receive sufficient material for the development of seed, the later blossoms are starved and fail to develop seed."

Concerning varietal susceptibility collaborators report as follows:

Immune varieties. -- Most durums, einkorn, and emmers, Indiana.

Very resistant varieties. -- Durums in Minnesota; a strain of Fultz and Indiana Swamp in Indiana.

Resistant varieties. -- Coker's Blue Stem, Purple Straw, and Red May in Arkansas; Kanred, Michikoff, and Purkoff in Indiana.

Susceptible varieties. -- Forward, Fulcaster, Fultz, Leap, and Pennsylvania 44 in Pennsylvania; Fulcaster (strains of), Michigan amber, and Red Rock in Indiana; Kanred, Marquis, and Turkey Red in Colorado; Kota in Minnesota.

Very susceptible varieties. -- Chul, Forward, Fulhio, Little Club, and Trumbul in Indiana; Defiance in Colorado; Red Rock in Pennsylvania.

(All reports from Colorado by L. W. Durrell; from Arkansas and Minnesota by the respective Department of Plant Pathology; from Indiana by E. B. Mains; and from Pennsylvania by R. S. Kirby).

On account of the occurrence of biologic forms of leaf rust, a single variety may exhibit different degrees of susceptibility when grown where different forms of the rust occur. This may account for the apparent discrepancies in the preceding statement.

E. B. Mains, (3) found that resistance to leaf rust is not limited to a small group of closely related or similar varieties of the hosts of the rusts studied, but often is present in varieties of quite diverse types. Resistance to the leaf rust of wheat has been found in the durum, emmer, spelt, poulard, polish einkorn, and common types, the club wheats being the only major group in which it has not so far been discovered although club types have been bred which are resistant. In the common wheats, resistance has been found in certain strains of such diverse groups as are represented by the varieties Bobs, Fultz, Kofod, Reseca, Democrat, Gladden, Valley, Fulcaster, Hussar, Pesterboden, Turkey, Kanred, Dixon, Imperial Amber, Norka, Mediterranean, and Webster, including winter and spring, bearded and beardless, hard and soft, and white and red-seeded types.

Control

See discussion on the control of this disease by dusting at the start of this section.

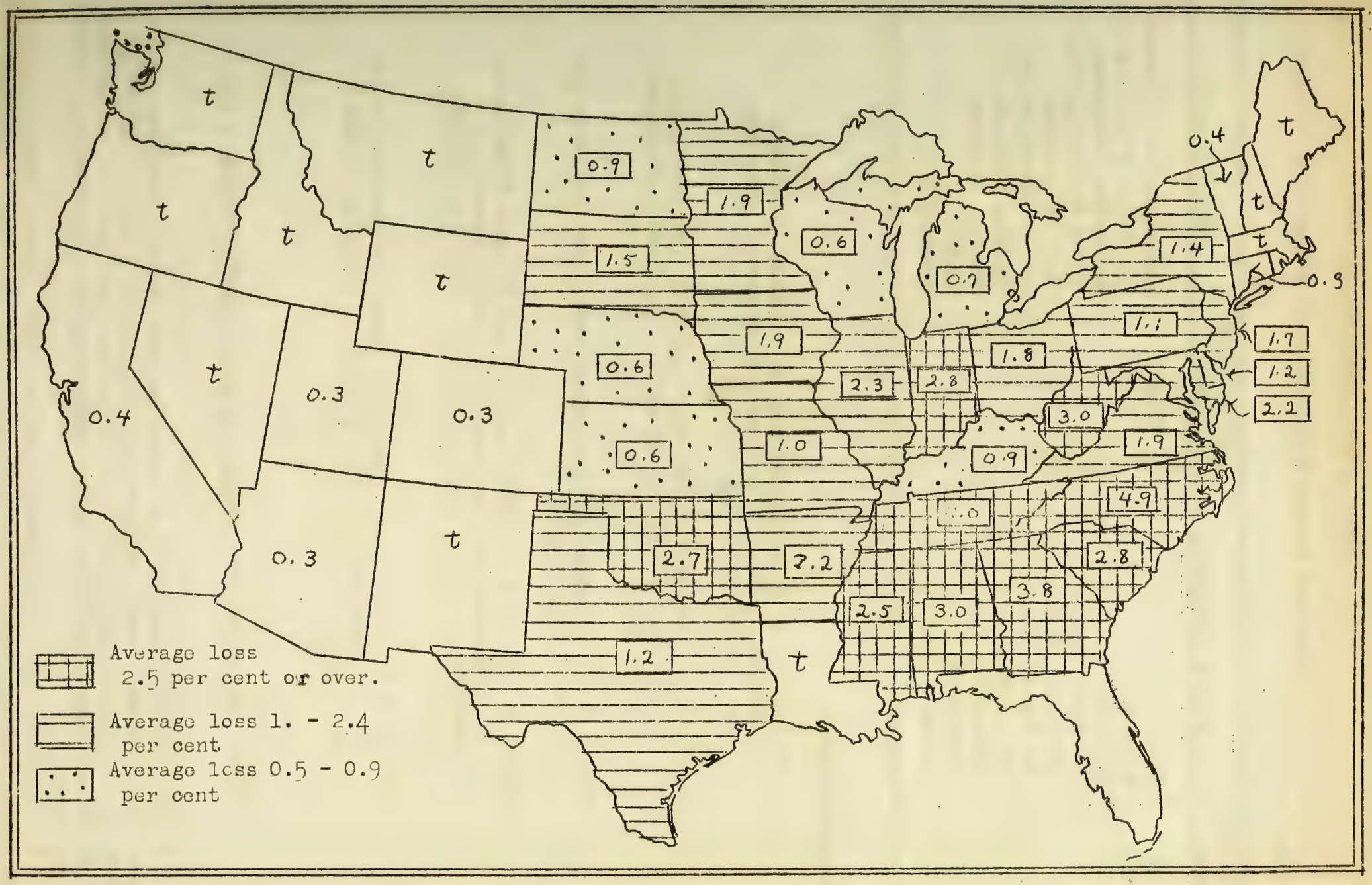

Fig. 14 . Average annual percentage loss from leaf rust of wheat, 1918 - 1926.

Table 35 . Percentage losses from leaf rust of wheat as estimated by collaborators, 1926.

Percentage loss	States reporting	Percentage loss	States reporting
6	Iowa	Trace	Massachusetts, Delaware
5	Indiana		Virginia, West Virginia
2	Michigan		Kentucky, Tennessee,
1	New York, South Carolina, Texas, Illinois, Wisconsin		North Carolina, Arkansas, Ohio, Minnesota, North Dakota, South
0.5	New Jersey, Pennsylvania, Maryland, Arizona, Oregon.		Dakota, Nebraska, Kansas, Montana, Idaho, Washington.

Recent literature:

1. Allen, R. F. A cytological study of Puccinia triticina physiologic form 11 on Little Club wheat. Jour. Agr. Res. 33: 201-222. Aug. 1, 1926.

2. Mains, E. B. The effect of leaf-rust, Puccinia triticina, on the seed production of wheat. (Abstract). Phytopath. 17: 40. 1927.

3. Mains, E. B. Studies in rust resistance. Jour. Heredity 17: 313-325. Sept. 1926.

4. Mains, E. B., C. E. Leighty, and C. C. Johnston. Inheritance of resistance to leaf rust, Puccinia triticina, in crosses of common wheat. Jour. Agr. Res. 32: 931-972. 1926.

5. Mains, E. B., and H. S. Jackson. Physiologic specialization in the leaf rust of wheat, Puccinia triticina Erikss. Phytopath. 16: 89-120. 1926.

STRIPE RUST CAUSED BY PUCCINIA GLUMARUM (SCHM.) ERIKS. & HENN.

Stripe rust has been found in seven western states, California, Arizona, Utah, Oregon, Idaho, Montana, and Washington, since it was first observed in the United States in 1915. It is most prevalent in the Pacific Coast States and Idaho, but is of minor importance and seldom causes over a trace of loss.

In 1926 D. E. Stevens reported that in Idaho, (Cereal Courier 18:117. May 20, 1926). "Stripe rust is more prevalent this year than it has been since 1917. Some varieties in the nursery already show 100 per cent infection.

Of the wheats in the varietal experiment Federation is the only one so far showing a very heavy infection." In Montana, H. E. Morris reported that stripe rust was present in the usual small amounts and in California, W. W. Mackie found less stripe rust than last year or the average year.

Stripe rust is known to overwinter, at least in Idaho, as mycelium in the tissue of its hosts, and becomes plentiful before harvest. It is usually most prevalent during years having heavy spring rainfall. This was true in Idaho this year as shown by C. W. Hungerford's statement that, "The wet weather in early June favored infection while later dry weather checked it."

The wheat variety Velvet Chaff was observed to be severely infected in Montana by H. E. Morris.

Recent literature:

1. Kharbush (S.) Recherches cytologiques sur blés parasités par Puccinia glumarum. Rev. Path. Vég. 13: 92-110. 1926.

SCAB CAUSED BY GIBBERELLA SAUBINETII (MONT.) SACC.

Scab has been reported from all Eastern wheat growing states. It is generally absent in the western states. During the past nine years it has been estimated to have caused the third largest loss in the United States of any disease attacking wheat, being exceeded only by stem rust and bunt. In certain sections like the Ohio and Upper Mississippi Valleys, and the Middle Atlantic Coast States it is very prevalent and destructive, often being responsible for a larger loss than any other disease. (See figures 5 and 15). Scab epithytotics are so dependent on weather conditions that the loss may be negligible during one year and most important the next, as for example in 1918 and 1919, when the average percentage losses were 0.4 and 5.27 respectively.

In 1926 practically all of the twenty-five states sending in estimates, with the exception of New York, reported that scab was less prevalent than in 1925 or in an average year. Estimates of losses for 1926 are given in table 36.

The unusually small amount of scab in 1926 was attributed by most collaborators to the lack of favorable weather for infection and spread. There were no long periods of rainy weather between heading and maturity of the wheat such as are required for scab development.

Dickson (2) in Wisconsin found that the seedling blight stage of this disease is greatly influenced by the soil temperature. Seedling blight was controlled by planting wheat in soil having a temperature as low as 46°F. but 21 per cent of the plants were killed at soil temperatures of 53°F. The percentage of blighted plants increased with an increase in the temperature up to 81°F. at which point about 60 per cent of the seedlings were killed.

Six years of careful study on varietal susceptibility in Minnesota has been reported on recently by Christensen and Stakman (1).

Wheat - Scab

For several years it has been recognized that one important control measure is to so arrange the farm rotations as to avoid following corn with wheat. In 1926 reports from three states, Ohio, North Dakota, and Pennsylvania were to the effect that scab is invariably much worse when wheat comes after corn in the rotation.

Concerning seedling blight, Dickson (3) states that in Wisconsin "Seeding made later than April 20, when the soil temperature was above 40°F., blighted badly resulting in poor stand and low yields." He says also that scabbed seed should be treated for thirty minutes in a .5 per cent solution of Uspulun, Semesan, or Germisan.

Table 36 . Percentage loss from scab of wheat, as estimated by collaborators in 1926. Figures in parentheses are maximum percentage infection observed in a single field.

Percentage loss	States reporting	Percentage loss	States reporting
1.	New York, North Carolina	Trace	Virginia, West Virginia Ohio, Indiana,
0.5	Pennsylvania, Illinois North Dakota.		Michigan, Wisconsin, Minnesota, Iowa (20),
0.4	Maryland		Missouri (0.5)
0.3	New Jersey		South Dakota.

Recent literature:

1. Christensen, J. J. and Stakman, E. C. Susceptibility of wheat varieties and hybrids to wheat scab in Minnesota. (Abstract) Phytopath. 17: 40-41. Jan. 1927.

2. Dickson, J. G. Making weather to order for the study of grain diseases. Wisconsin Agr. Exp. Sta. Bul. 379: 3-36. Jan. 1926.

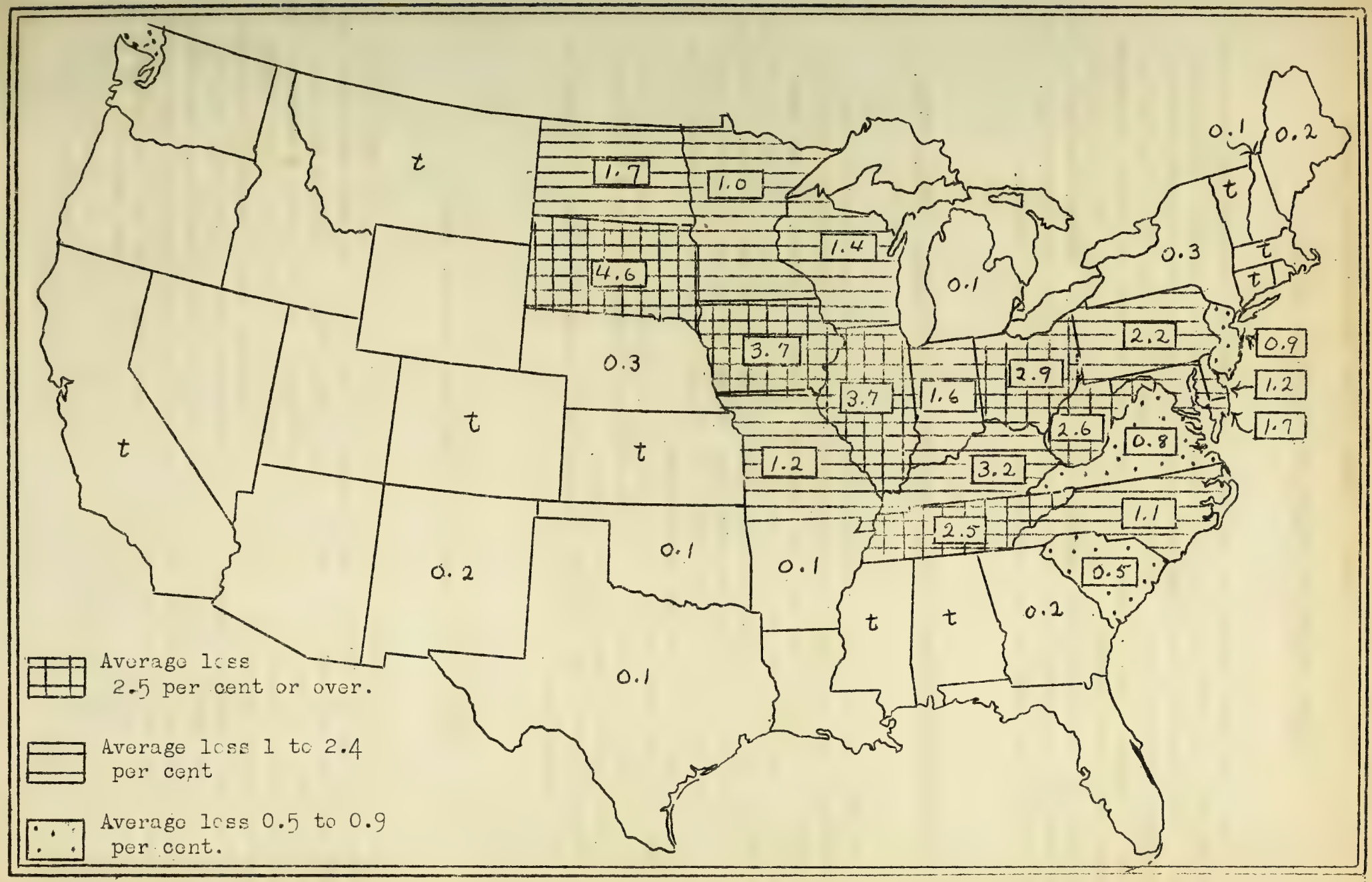

Fig. 15 . Average annual percentage loss caused by scab of wheat, 1918 - 1926.

ERGOT CAUSED BY CLAVICEPS PURPUREA (FR.) TUL.

Ergot has been reported on wheat from most of the Middle Atlantic and Middle West States and from Arizona. It rarely causes appreciable damage. The greatest loss occurs in the hard spring wheat sections of the Dakotas and Minnesota. In 1926 the loss from ergot was negligible, with the following four states reporting its presence - Indiana, Wisconsin, Minnesota and North Dakota. In North Dakota it was too dry in June for germination of the sclerotia, according to Brentzel. Durum wheats are in general more susceptible than the common spring and winter varieties. The variety Monad was said to be very susceptible in North Dakota.

ANTHRACNOSE CAUSED BY COLLETOTRICHUM GRAMINICOLUM (CES.) WILS.

Anthracnose has been reported from all the states east of the Great Plains with the possible exception of Michigan, Missouri, Florida, North Carolina, West Virginia, and the New England states. It is most prevalent in the Ohio Valley and Middle Atlantic states. Except in Ohio, Pennsylvania, and Virginia, it appears to be of minor importance. In Ohio, it has been reported during the past nine years as one of the most destructive diseases in the state, while in Pennsylvania and Virginia it has often been ranked as of major importance.

In 1926 collaborators' estimates of losses are: 0.5 per cent in New York and Ohio, 0.3 per cent in Pennsylvania, and a trace in Indiana, Virginia, Illinois, Wisconsin, and Iowa.

Tehon reported that Fultz appears to be resistant while Turkey and Kanred are susceptible in Illinois.

GLUME BLOTCH CAUSED BY SEPTORIA NODORUM BERK.

Glume blotch has been reported from most states east of the Rocky Mountains and from California and Oregon. It seems to be most prevalent in New York and Pennsylvania and south of the Ohio River. The disease is favored by excessive rainfall between heading and maturity and attains epiphytotic proportions only under such conditions. In 1926 glume blotch was about as prevalent as in 1925 or in an average year, judging from reports from 26 states. Losses reported by collaborators were 1 per cent in New York (15) and Pennsylvania, (80), 0.5 per cent in Maryland, and a trace in West Virginia, Arkansas, Ohio, Illinois (5), Wisconsin, Iowa, and Minnesota. The figures in parentheses indicate the maximum percentage of infection found in any one field. Under Illinois conditions, Tehon reported that Fulcaster, Fultz, and Valley were resistant, While Turkey and Kanred were slightly susceptible. In Pennsylvania, Airby observed Velvet Chaff to be much more susceptible than varieties like Leap and Forward.

Wheat - Glume Blotch: Speckled Leaf Blotch

Some of the reports of collaborators follow:

Pennsylvania: Glume blotch was more prevalent than in 1926. It was observed to be shriveling the kernels in the infected spikelets to a greater exten than usual. From 10 to 40 per cent of the spikelets were usually found to be infected. (Kirby).

West Virginia: Slight amount in most fields, no apparent importance. (Sherwood).

Arkansas: Less noted than in last nine years. (Dept. Plant Path.).

Ohio: This disease is quite general in northern Ohio and is causing quite a distinct loss. In some of the fields in which we have made definite counts it will cause a reduction in yield of about 12 per cent. (H. C. Young).

Illinois: The fungus has hitherto been known in Illinois only as the cause of rare cases of glume blotch. It has been found recently in Schuyler and McDonough Counties in considerable abundance on several varieties, attacking the topmost nodes. The wheat there is now cut and the heads on diseased stalks generally show poorer grain and fewer filled spikelets. (Tehon).

SPECKLED LEAF BLOTCH CAUSED BY SEPTORIA TRITICI DESM.

Speckled leaf blotch is common but of slight importance in most of the states east of the Rocky Mountains. In the Far West it has only been reported to the Survey from California, Colorado, and Idaho. In 1926, reports from 27 states indicated that leaf blotch was slightly less prevalent than in 1925, and considerably less prevalent than usual. The small amount was attributed by several collaborators to the dry spring. The losses estimated were 0.5 per cent in Maryland, 0.1 per cent in Illinois, considerable in California, and a trace in New York, Pennsylvania, Wisconsin, Minnesota, Colorado, and Idaho.

Illinois: Found rarely in the south, commonly in the central counties, and not at all in the north. (Tehon).

Colorado: Found in seedling stage, little damage. (Durrell).

California: Septoria is common in all wheat fields, especially in the northern portion of the state, and has in many instances caused considerable damage from early leaf pruning. (Mackie).

BLACK CHAFF CAUSED BY BACTERIUM TRANSLUCENS UNDULOSUM SMITH, JONES, & REDDY.

Black chaff is most frequently reported from the Great Plains area and the Missouri River Valley States. It has been found only occassionally east of the Mississippi River. It is usually not considered to be of much importance, causing on the average less than one per cent loss even in such states as Kansas, North Dakota, South Dakota, and Idaho where it is most prevalent. In 1926 it was less prevalent than in 1925 or in an average year, as the collaborators all reported less than last year and all but two reported less than in an average year. Dry weather was generally given as the cause for this marked decrease in prevalence. Melchers in Kansas has pointed out that moderately high temperatures (above 60°F.) are most favorable for the disease and that in order to have an epiphytotic of black chaff it is necessary to have excessive moisture almost continuously between the emergence of the wheat heads and the dough state. In North Dakota it was estimated to have caused a 0.5 per cent loss, in Montana 1 per cent, and in Minnesota, Iowa, Missouri, South Dakota, and Colorado collaborators report only a trace of loss. The highest infection reported was 5 per cent, observed in a field in North Dakota.

In North Dakota, Brentzel has found Kota to be more susceptible to this disease than Marquis and Ruby.

Recent literature:

1. Smith, Erwin F. Black chaff of wheat in Russia. Science n. s. 63: 305-307. Mar. 19, 1926.

The author had suspected that black chaff was introduced from Russia, since it was not observed in this country until after numerous importations of Russian wheat. Janczewsky now reports that black chaff occurs in Russia. He found it in wheat collected in 1910 in the Province of Mohilew and in 1916 in Poltawa; and it was observed in many localities in Russia in 1924.

BASAL GLUME ROT CAUSED BY BACTERIUM ATROFACIENS McC.

In general basal glume rot is of minor importance, seldom causing over a trace of loss. Prior to 1926 it was reported only from New York, Pennsylvania, Iowa, Missouri, Arkansas, North Dakota, Nebraska, Kansas, Oklahoma, and Montana. In 1926 Tehon reported it to the Plant Disease Survey for the first time from Illinois where it was found June 22 at Lovington. It was estimated to cause only a trace of loss and the highest infection found was only 1.1 per cent. Tehon considered Kanred, Fulcaster, Turkey and Fultz susceptible. The only other report was from Pennsylvania, where the disease was found in the northwestern section of the state, causing only a trace of loss and not occurring in amounts greater than 3 per cent in any one field.

POWDERY MILDEW CAUSED BY ERYSIPHE GRAMINIS DC.

Powdery mildew is prevalent in most of the northeastern quarter of the country, and has been reported from many of the western states. In general it is of only minor importance. During most years only one or two states report more than a trace of loss and the maximum loss reported to the Survey is 2 per cent from Pennsylvania in 1924. The disease is most troublesome in New York, Pennsylvania, and Maryland, but even in these states the average loss is only a fraction of one per cent. In other sections of the country the loss is negligible, with the disease occurring only in low places in fields where the wheat stands thick or is lodged. Powdery mildew requires considerable wet weather for its best development and this is apparently the reason why the destructive attacks are limited to the humid Atlantic Coast States.

In 1926, of reports from 25 states there were 6, the most prominent of which were Arkansas, Colorado and Arizona, which indicated an increase in the amount of mildew over 1925, and two which showed a slight decrease. The others state that there seemed to be about the average amount. Collaborators' estimates of losses in 1926 were: 1 per cent, New York (0.5) and Arizona (trace); 0.5 per cent, Pennsylvania (0.6): 0.3 per cent, Maryland (0.1): and a trace each in Texas, Ohio, Wisconsin, Minnesota, Nebraska, Montana, and Colorado. The figures in parentheses are the average percentage loss from 1918 to 1926. Heavy spring rains probably explain the unusually large loss in Arizona, where the disease does not often occur.

The variety Little Club was reported as very susceptible in Idaho and Kentucky. The Department of Plant Pathology of the New Jersey Agricultural Experiment Station submitted the following data from observations made in 1926.

Very resistant varieties: Fulcaster, Kanred, Four-Row Fultz, Red Row, Dawson's Golden Chaff, Pennsylvania 44.

Resistant varieties: China, Red Wave, Kentucky R-50, Missouri Blue Stem, Lancaster-Fulcaster, Gladden.

Susceptible varieties: Red Rock, Leaps Prolific, Foward, Currell's Prolific, Kentucky R-47, Fultz, Leaps Prolific N-12.

Very susceptible varieties: Shepherd, Ashland, Purple Straw, Ohio 127.

In Pennsylvania, surveys of fields and varietal plots by R. S. Kirby gave the following percentages of infection.

Variety	No. fields surveyed	Percentage infection
Pennsylvania 44	68	1.7
Forward	29	1.7
Fulcaster	36	2.9
Leap	84	3.9

TAKE-ALL CAUSED BY OPHIOBOLUS GRAMINIS SACC.

Since its appearance in America, take-all has been reported from Arkansas, California, Indiana, Kansas, Maryland, New York, North Carolina, Oregon, Tennessee, Virginia, and Washington, and from the provinces of Saskatchewan and Alberta, Canada. In 1926, L. E. Melchers summarized the Kansas situation thus: "Foot-rots and especially take-all were not common in Kansas in 1926. Only a few fields in those counties that had a normal rainfall showed some foot-rot. A dry spring very evidently had a marked influence in suppressing foot-rot damage. Many fields known to have soil infestation showed no disease." H. P. Barss stated that in Oregon, "The disease was severe in a Lane County field of winter wheat on ground that had been summer fallowed after clover sod had been turned down. Other reports were received also." In New York, M. F. Barrus reported that take-all was local in distribution, and caused a 0.1 per cent reduction in yield with a maximum infection of 1 per cent. In California, according to W. W. Mackie, "Take-all was less prevalent than usual. It was observed to cause the greatest injury in April when the wheat started to head. The variety Hard Federation showed most damage."

Recent literature:

1. Frazer, W. P., Russell, R. C., and P. M. Simmonds. The take-all disease in Canada. (Abstract) Phytopath. 16: 80-81. 1926.

2. Jones, S. G. The development of the perithecium of Ophiobolus graminis, Sacc. Ann. Bot. 40: 607-629. July 1926.

3. Parisot. Le pietin du blé. - Comptes rendu Acad. Agric. France, 12: 565-569. 1926.

4. Petri, L. Osservazioni sul 'mal del piede' del frumento (Observations on 'foot-rot' of wheat.) Boll. R. Staz. Pat. Veg. 6: 174-178. 1926.

HELMINTHOSPORIUM BLIGHT CAUSED BY HELMINTHOSPORIUM SATIVUM PAM., KING, & BAK.

Helminthosporium sativum causes primarily a foot and root rot, but it may also attack all other parts of the plant. It is most prevalent in the Great Plains, Middle Western, and Middle Atlantic states. It has been reported at times as unimportant in other states scattered throughout the country. The disease has caused the largest loss in North Dakota, where the reduction in yield varies in different years from 0.5 to 10 per cent.

In 1926 reports from collaborators in twenty-two states indicate that it was slightly more prevalent than in 1925, but of about the same prevalence as usual. Collaborators' estimates of percentage reduction in yield are, 1.5 per cent, North Dakota, 0.5 per cent, New York and Kansas, 0.4 per cent, Pennsylvania, trace in Maryland, West Virginia, Virginia, Wisconsin, Minnesota, Mississippi, Idaho and California,

Wheat - Helminthosporium blight: Nematode:
Other Diseases and Injuries.

In North Dakota, Brentzel observed that there was more foot rot than head and grain infection and that damage caused was apparently less severe than the average.

In Pennsylvania, Kirby reported that although Helminthosporium blight was seldom found except where wheat followed wheat or oats, under these conditions it often caused losses of 10 to 20 per cent.

The variety Pennsylvania 44 was reported as resistant, and Forward, Leap, Fulcaster, and Longberry Red as susceptible, in Pennsylvania. Brentzel found Monad and Kubanka to be very susceptible in North Dakota.

NEMATODE, TYLENCHUS TRITICI (STEIN.) BAST.

The wheat nematode has been reported from the Eastern states of Maryland, Virginia, West Virginia, North Carolina, South Carolina and Georgia, and the western states of California and Arizona. This can be considered as one of the minor diseases since in no state have the losses aggregated over a trace, except locally. Nematode was definitely reported with specimens for the first time from Maryland in 1926. R. A. Jehle and F. W. Oldenburg found a single head of infected wheat in Howard County and subsequently a survey by these men and members of the Office of Cereal Crops and Diseases revealed traces on a few farms in Montgomery County. In Virginia, the nematode disease was found in two fields in 1926, one field in Loudoun County had 5 per cent infestation and one in Fluvanna County 14 per cent, according to Fromme and Godkin. In West Virginia, Sherwood reported that: "Only local areas were affected in the eastern mountain section bordering Virginia."

Recent literature:

1. McConnell, H. S. Ext. Service, Univ. Maryland Circ. 59: 4 pp. Jan. 1926.

OTHER DISEASES AND INJURIES.

Cladosporium herbarum (Pers.) Lk., sooty mold, caused some damage in Colorado. (Le Clerg).

Epicoccum glumarum Daniels, glume smudge. Traces found in fields in Champaign and Randolph Counties, Illinois, on June 26, when the wheat was in the dough stage. This is the first report of this disease from Illinois. (Tehon).

Fusarium sp., pink rot, was reported from California. It occurred in all parts of the state and was about as prevalent as in 1925, when it caused about 4 per cent loss. It caused the death of the wheat plants in all stages. (Mackie).

Wheat -- Other Diseases and Injuries

Heterodera schachtii Schmidt, Nematode. From Saskatchewan, Canada, R. C. Russell reported that in the spring of 1926 the sugar beet nematode, Heterodera schachtii, was found occurring in four widely separated fields of wheat in the Humboldt district. The nematodes were present on the secondary, as well as the primary roots. This nematode has not been reported on wheat in the United States so far as is known.

Hormodendrum cladosporioides Sacc., sooty mold, was more prevalent than usual in California (Mackie).

Sclerotium rhizodes, Auers., foot-rot. This disease, which was previously reported in 1922, occurred in Idaho again in 1926. According to Hungerford, June 1, "A severe infection of the Sclerotium disease on wheat has again been reported this spring. A survey of this section revealed the fact that over 75 per cent of the winter wheat in parts of Fremont and Teton Counties had to be resown to spring wheat due to this disease. It was also noted that early sown wheat suffered the most. Fields sown after September 15 showed little injury, while many early sown fields were a total loss." Pape (3), writing in Germany, states that, judging from Hungerford's description of the disease (Phytopath. 13: 463-464. 1923), the causal fungus is possibly Typhula graminum.

Crinkle joint, cause unknown, has been observed in northeastern Montana for the past three years. In 1926 it was quite serious in some fields of Marquis wheat in Valley and Daniels Counties, affecting between a trace and 10 per cent of wheat stalks. The breaking of the stems is probably due to wind pressure or hail and the bending of the joints above the break is a normal phenomenon. (P. A. Young).

Distortion of wheat heads, cause unknown, was found in California and Oregon. In Oregon as high as 30 per cent of the wheat heads in a field of White Winter wheat were affected. (R. J. Haskell).

Purple leaf spot, cause unknown. A trace was observed in one field of Fulcaster wheat in Clinton County, Missouri. (Archer).

Root rots, cause undetermined. In Wisconsin an unknown foot rot caused very slight losses at Madison. (Vaughan). Unknown foot rots (Fusarium, Helminthosporium, etc.) caused a 1 per cent loss in Minnesota. (Sect. Pl. Path). In Kansas the high temperatures and drought undoubtedly held foot rots in check so that there was only a trace of loss. (Melchers). A foot rot (apparently caused by Fusarium sp.) was found at State College, Pennsylvania, on June 16, causing a slight loss in some of the college breeding plots. (Kirby). Scattered occurrences of foot rots of unknown cause, and of slight importance were reported in Montana and Idaho.

Stripe, cause unknown. Traces were reported from Pennsylvania and Illinois. Tehon in Illinois observed less stripe on Fulcaster and Fultz than on Kanred.

Recent literature on miscellaneous diseases of wheat.

1. Jones, J. S. and G. A. Mitchell. The cause and control of yellow berry in Turkey wheat grown under dry-farming conditions. Jour. Agr. Res. 33: 281-292. Aug. 1, 1926.

2. Noble, R. J. Downy mildew of wheat. Sclerospora macrospora, Sacc. Agr. Gaz. New South Wales 37: 204-208. Mar. 1, 1926.

3. Pape, H. Die Sclerotium-Krankheit der Wiesengraser, insbesondere des Rohrglanzgrases. Illus. Landw. Zeit. 46: 295-296. June 4, 1926.

4. Spafford, W. J. Some diseases of wheat crops and their treatments. Dept. Agr. South Australia. Bul. 190: 1-16. 1925.

5. Webb, Robert W. Certain factors influencing the development of the mosaic disease in winter wheat. (abstract). Phytopath. 17: 41. Jan. 1927.

RYE

STEM RUST CAUSED BY PUCCINIA GRAMINIS PERS.

In 1926 stem rust of rye caused a smaller loss than in any previous year on record. A trace was reported from Massachusetts, Pennsylvania, Maryland, Georgia, Texas, Michigan, Wisconsin, Minnesota, North Dakota, South Dakota, Nebraska, Colorado, and California and 0.5 per cent from Connecticut. This decrease in injury apparently was due to the unfavorable, hot dry weather which prevailed during the maturity of the rye crop, and to the eradication of the barberry bushes in many sections. Both California and Wisconsin report fields with 100 per cent infection, but the rust apparently came late and did little damage. The dates of earliest appearances as reported by collaborators were, April, Sacramento, California; June 14, Madison, Wisconsin; June 18, Lake City, Minnesota; July 10, Fort Collins, Colorado; and July 28, Clarion County, Pennsylvania.

Two selections from the variety Abruzzes showed high resistance to stem rust, leaf rust, and powdery mildew according to Mains (1).

Recent literature:

1. Mains, E. B. Rye resistant to leaf rust, stem rust, and powdery mildew. Jour. Agr. Res. 32: 201-221. 1926.

LEAF RUST CAUSED BY PUCCINIA DISPERSA ERIKS.

During the past year leaf rust apparently caused about one-third less loss than it did during 1925. Losses reported by collaborators were 1 per cent in New Jersey and Maryland, 0.5 per cent in Pennsylvania, 0.2 per cent in Indiana and Illinois, 0.1 per cent in Georgia, and traces in Connecticut, New York, Virginia, Kentucky, Florida, Mississippi, Michigan, Wisconsin, Iowa,

Nebraska, Kansas, Oregon, and California. The lack of prevalence of this rust was due to the generally dry, cool spring which retarded the development and spread of the fungus. R. E. Vaughan reported overwintering of the rust in Wisconsin, and stated that it was found in April as soon as the plants started after snow was melted.

Recent literature:

1 Mains. E. B. Studies in rust resistance. Jour. Heredity 17: 313-325. Sept. 1926.

2. Mains, E. B. Rye resistant to leaf rust, stem rust, and powdery mildew. Jour. Agr. Res. 32: 201-221. 1926.

ERGOT CAUSED BY CLAVICEPS PURPUREA (FR.) TUL.

Ergot is found in nearly every state where rye is grown. In 1926 the loss due to it was largely confined to the principal rye growing states, and was slightly above the average, such as occurred last year, but still considerably lower than that caused in years of severe ergot, as for example, 1924. In Illinois, Tehon writes that abundant infection of rye often occurred when it was mixed in wheat. In Michigan Nelson states that there was apparently more of this disease than for several years, while in Wisconsin, Vaughan based estimates of more loss than usual on statements of millers. The percentage losses as estimated by collaborators were: 2 per cent, Michigan; 1.5 per cent Wisconsin; 1 per cent, North Dakota and South Dakota; .1 per cent, Indiana; and trace, Massachusetts, New York, New Jersey, Pennsylvania, Ohio, Illinois, Minnesota, Iowa, and Nebraska.

ANTHRACNOSE CAUSED BY COLLETOTRICHUM GRAMINICOLUM (CES.) WILS.

In general anthracnose was reported as being less destructive than in 1925. In Pennsylvania, where the disease was about one-third less prevalent than usual, it still caused a greater loss than any other two rye diseases taken together. The losses were estimated as follows: 4 per cent, Missouri; 2 per cent, Pennsylvania and Mississippi; .5 per cent, Wisconsin; and .1 per cent, Indiana. As high as 85 per cent infection was observed in a back yard patch of rye in Missouri. Other maximum percentages noted were 25 in Pennsylvania and 15 in Mississippi.

Rye - Stem Smut: Loose Smut: Scab
Powdery Mildew.

STEM SMUT CAUSED BY UROCYSTIS OCCULTA (WALLR.) RABH.

This smut is largely confined to the north central and eastern parts of the United States, but has been reported from as far west as Arizona and Idaho. It is not as destructive as many of the other smuts attacking cereals, since it has never been reported as causing over one and one-half per cent loss in any state. In 1926, when only four states reported its occurrence, the loss was several times smaller than for any other year on record. The estimated losses were: Pennsylvania 0.6 per cent, and Connecticut, Michigan and Minnesota each a trace.

LOOSE SMUT CAUSED BY USTILAGO TRITICI (PERS) ROSTR.

No reports of this smut were received this year. Previously it has been reported from nine states, in none of which was it prevalent enough to be considered of economic importance.

SCAB CAUSED BY GIBBERELLA SAUBINETII (MONT.) SACC.

The head blight, or scab, of rye was observed in 1926 in the following five states; Maryland, Tennessee, Indiana, Wisconsin, and Iowa. It was reported as not reducing the yield in any of these states, but in Wisconsin, Vaughan reported a two per cent loss in grade. The greater loss in Wisconsin was due to rains coming before harvest in contrast to subnormal rainfall in most of the other states.

Recent literature:

1. Dounin, M. The fusariosis of cereal crops in European Russia in 1923. Phytopath. 16: 305-308. 1926.

2. Schaffnit, E. and A. Volk. Ueber die Roggenfusariose und ihre Bekämpfung durch die 'Trockenbeize.' Zeitschr. Pflanzenkrankh. 36: 42-52. 1926.

POWDERY MILDEW CAUSED BY ERYSIPHE GRAMINIS DC.

Powdery mildew was observed in Connecticut, New York, Pennsylvania and Maryland, Indiana, Wisconsin, and California. The rather dry spring seemed to retard its development so that it did not cause any appreciable damage. In the East, the mildew caused most of its damage in the spring, but in

Wisconsin, Vaughan reports that it is a fall problem of minor importance.

Mains (1) has reported on two rye selections from the Abruzzes variety which showed high resistance to powdery mildew.

Recent literature:

1. Mains, E. B. Rye resistant to leaf rust, stem rust and powdery mildew. Journ. Agr. Res. 32: 201-221. 1926.

OTHER DISEASES.

Helminthosporium sativum Pam., King, & Bak., leafspot. Traces of this disease occurred in Pennsylvania and California. In Pennsylvania it was general while in California it was reported only from one locality. In Minnesota a species of Helminthosporium was reported as causing considerable root rot in some sandy regions in Anoka and Isanti Counties.

Hormodendrum cladosporioides Sacc. In California it caused considerable damage in the rye growing districts along the coast and in the great interior valleys. (Mackie).

Rhynchosporium secalis (Oud.) Davis, scald. In Illinois L. R. Tehon saw a field of rye having a 60 per cent infection of what appeared to be Rhynchosporium blight.

Septoria secalis Prill. & Delacr. A leaf spot, apparently caused by Septoria, was reported from Jacksonville, Illinois, by L. R. Tehon.

Stripe of ryeleaves, cause unknown. L. R. Tehon states, "This disease, reported for the first time from Illinois, is the same in all outward appearances with the stripe disease of wheat."

B A R L E Y

Judging from the estimates of collaborators for the past eight years, the barley crop annually suffers a loss from diseases ranging from about 4 per cent to 11 per cent of the crop with an average of nearly 6 per cent. Covered smut is apparently the most important disease with an average loss of 1.45 per cent. Then follow, in order of importance, stripe, (1.13 per cent), stem rust (1.12 per cent), loose smut, (0.77 per cent), and leaf rust, (.004 per cent).

COVERED SMUT CAUSED BY USTILAGO HORDEI (PERS.) KELL. & SW.

As in previous years, this most important disease of barley was reported from nearly all of the barley growing sections. In general, the largest losses occur in the Southwest and the Far West.

Reports from twenty-seven states indicate that more than normal amounts were present in 1926 but in general there was less than in 1925. In California, where the largest loss occurred, 40 per cent was observed in one field. The estimates of 1926 losses are given in Table 37 .

White Hulless and beardless varieties were reported from Minnesota and Pennsylvania as being very susceptible to this smut.

Table 37 . Estimated reduction in yield of barley due to covered smut for 1926 and for the period 1918 to 1925, as estimated by collaborators.

Percentage loss	States reporting	Percentage loss	States reporting
6	California (3.3)		Maryland (1.1), Iowa (1.2)
4	Montana (1.9)		Missouri (1), North
3.3	Virginia (1.9)		Dakota (0.9), Idaho (1.1)
3	Colorado (.13)	0.75	Minnesota (0.8)
2.5	Tennessee (2.5)	0.5	Wisconsin (0.4), Texas,
2	Kansas (2)		Oregon.
	Arizona (1.4)	Trace	West Virginia *
1.5	Pennsylvania (0.9)		South Carolina *
1	New York (0.9)		Arkansas (6)

Figures in parentheses equal average percentage loss from 1918 to 1925.

*Disease percentage estimated but insufficient data for average.

Recent literature:

1. Lambert, E. B., H. A. Rodenhiser, and H. H. Flor. The effectiveness of various fungicides in controlling the covered smuts of small grains. Results of the cooperative cereal seed treatment project of the Crop Protection Institute. Phytopath. 16: 393-411. 1926.
Reports that covered smut of barley was best controlled by formaldehyde.

2. Rump, L. Studien über den Gerstenhartbrand (Ustilago hordei Kell. & Sw.) Forsch. auf dem Gebiet der Planzenkrank. u der Immunität im Pflanzenreich 2: 21-76. 1926.

3. Schaffnit, E. Zur Physiologie von Ustilago hordei Kell. u Sw. Ber. Deutsch. Bot. Gesellsch. 44: 151-156. 1926.

LOOSE SMUT CAUSED BY USTILAGO NUDA (JENS) KELL. & SW.

The loose smut of barley probably occurs in every state in which barley is grown. The greatest loss apparently is caused in the northern part of the winter barley section, extending from Oklahoma to Indiana, Pennsylvania and southward, where it is the most important barley disease. Within this area the average loss is about twice as much as in the spring barley section to the north. The smallest loss seems to occur in the arid regions of the Far West. Reports from twenty-seven states show that this smut was about equally severe in 1926 and 1925 and that loss was almost exactly the same as the average for the years 1918 to 1925. Estimates of losses for 1926 are given in Table 38. Losses in individual fields were reported as high as 20 per cent for one field in California and 11 per cent for a field in Virginia. The following reports concerning varietal susceptibility to loose smut have been sent by collaborators. Varieties very resistant, Manchuria and Minn. 184 in Minnesota; varieties resistant, Featherstone in Pennsylvania; varieties susceptible, Lion and White Hulless in Minnesota, Alpha in New York and Pennsylvania, and Tennessee Winter in Pennsylvania. For information on control see section on seed treatment, page 111 .

Table 38 . Estimated reduction in yield of barley due to loose smut for 1926 and for the period 1918 to 1925, as estimated by collaborators.

Percentage loss	States reporting	Percentage loss	States reporting
4	Illinois (1.8)	1.5	Minnesota (.8)
3.5	Pennsylvania (3.2)	1	North Dakota
3.	Montana (1.6)		Iowa (1.2), Wisconsin,
2.	South Dakota (.8)		South Carolina (1.6)
	Kansas (1.9)		Virginia (3.5)
	Michigan (.9)	0.5	Arizona (.8), Texas (.8)
	Tennessee (3.1)	Trace	California (1.)
	Maryland (2.6)		Colorado (.4)
	New York (1.9)		Idaho, Oregon.

Figures in parentheses equal average percentage loss from 1918 to 1925.

Recent literature:

1. Tisdale, W. H., and Marion A. Griffiths. Strains of Ustilago nuda and certain host-relationships. (Abstract). Phytopath. 17: 42. Jan. 1927.

STEM RUST CAUSED BY PUCCINIA GRAMINIS PERS.

This rust has been reported from most of the states growing barley. Losses from it are almost completely confined to the barberry eradication area, and within this largely to Iowa, Minnesota, Wisconsin, and the Dakotas, where the average estimated reduction in yield is from 2 to 5.85 per cent in each state. Before 1923 stem rust was the most destructive disease of barley in most of the Central West. As will be seen from the graph (Figure 16) the loss due to this rust during the past eight years has been on the decrease. During the past two or three years it has become a disease of only moderate importance.

Reports from twenty-eight collaborators show that, in general, stem rust was not so destructive in 1926 as in 1925, and that the loss in 1926 is the lowest of any on the records of the Plant Disease Survey. Table 39 gives the estimates of percentage losses by states. Rust was reported to be severe on barley near infected barberry bushes in Illinois, Pennsylvania, and Colorado. The dry weather apparently greatly reduced the rust in many states. In Iowa, M. A. Smith states that: "Very dry, windy weather at the time ascospores were being discharged very likely was a factor in the development of only a light sprinkling of uredinial infection which followed."

On the other hand, rain and cool weather in March and April were favorable to the disease in Arizona, according to Streets.

Concerning varietal susceptibility, Minnesota reports that the variety Lion is resistant and that most other varieties are susceptible, and in Colorado L. W. Durrell reports that Colsess, Hanna, and Trebi are susceptible.

Table 39. Estimated reduction in yield of barley due to stem rust for 1926 and for the period 1918 to 1926, as estimated by collaborators.

Percentage loss	States reporting	Percentage loss	States reporting
3	Arizona (1)	Trace	North Dakota (2.1)
1	New York (0.3)		Wyoming, Colorado (1)
	Iowa (5.)		Nebraska (1), Kansas
0.6	Texas		Minnesota (2.28)
0.5	California		Michigan (1.2)
	South Dakota		Pennsylvania
	Wisconsin (2)		Maryland
0.4	Illinois (1.3)		Ohio, Oregon.

Figures in parentheses equal average percentage loss from 1918 to 1926.

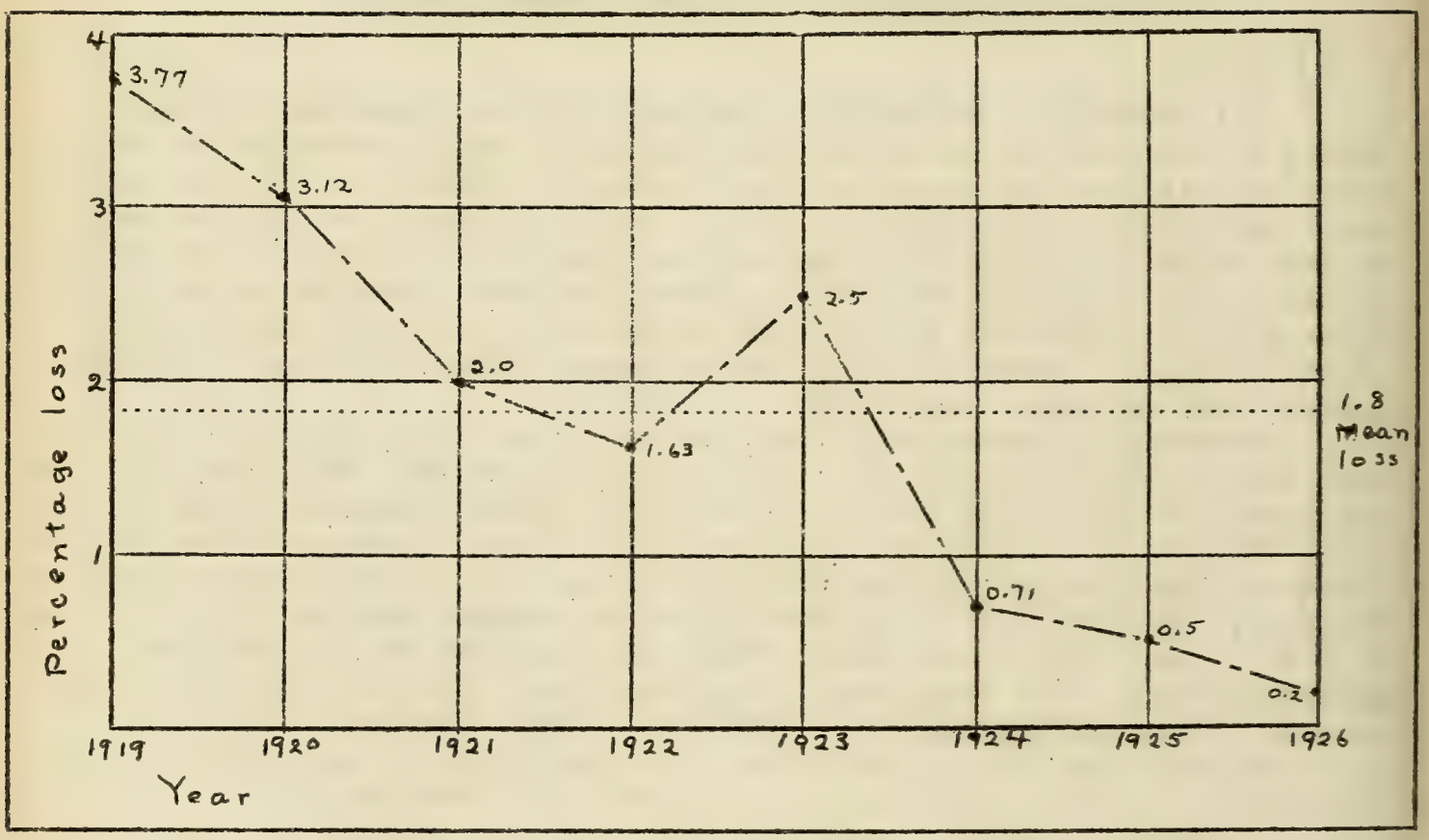

Fig. 16 . Estimated average percentage loss in barley from stem rust in the 13 barberry eradication states from 1919 to 1926.

LEAF RUST CAUSED BY PUCCINIA ANOMALA ROSTR.

Leaf rust of barley is present over a considerable area of the United States but is rarely reported from the southern and arid western states and is not usually considered to be of more than slight importance. In 1926 dry weather during the spring reduced its prevalence to less than that in 1925. Arizona reported the largest loss, 2 per cent. In Illinois the loss was 0.5 per cent. Twelve other states reported finding small amounts but estimated the losses at a trace. In Oregon, H. P. Barss reported that: "The rust was common and much more abundant than usual in the western part of the State."

Mains (1) has reported that 49 strains of barley out of 697 studied showed a very high resistance in greenhouse tests, and a still larger number were resistant in the field. Marked leaf-rust resistance has been found in both six-rowed and two rowed, hooded and awned, white and blue-seeded, including certain lines of such varieties as Oderbrucker C. I. 940, Brewing C. I. 657, Featherstone C. I. 1120, Horsford C. I. 507, Black Hulless C. I. 1097, Nepal C. I. 262, Heil's Hanna No. 3 C. I. 682, Black Arabian C. I. 202, etc.

Recent literature:

1. Mains, E. B. Studies in rust resistance. Jour. Heredity 17: 313-325. Sept. 1926.

2. Ducomet, V. A propos de la forme ecidienne de Puccinia simplex. Rev. Path. Vég. et Entom. Agr. 13: 86-91. Jan.-Mar. 1926.

STRIPE CAUSED BY HELMINTHOSPORIUM GRAMINEUM RABH.

Stripe has been reported in most of the barley growing states. It is most destructive in the Middle West, and in California and Utah, where the loss averages from 1.5 to 2 per cent. The disease appears to be of little economic importance in most of the other states.

In 1926 there was slightly less stripe than in 1925 when the estimated average loss in the United States was 1.5 per cent. The 1926 loss is very nearly the eight year average of 1.13 per cent. In Wisconsin, Vaughan reported a maximum infection of 25 per cent. In Arizona one forty-acre field planted with untreated seed from California showed 20 per cent of dead plants according to Streets.

Table 40 gives estimates of losses in 1926.

Table 40 . Estimated reduction in yield of barley due to stripe for 1926 and for the period 1918 to 1925, as estimated by collaborators.

Percentage loss	States reporting	Percentage loss	States reporting
2.5	Illinois (1.6)	Trace	Connecticut (.5)
	Wisconsin (1.1)		Maryland
2	California (.6)		Pennsylvania
1.5	North Dakota (1.1)		Virginia
1	New York (.7)		Michigan (1.4)
	North Carolina		Iowa (4.2)
	South Carolina		Kansas, Nebraska
	Minnesota (1.2)		Montana
	South Dakota (2.7)		Arizona
0.5	Colorado (1.3)		Idaho, Oregon.

Dry weather was reported as the reason for the small amount of this disease in Illinois, Michigan, and South Dakota, and in Iowa, Gilman reported that an early spring drought very greatly reduced the amount of stripe. In Iowa, in fact, the disease caused only a trace of loss in 1926 as compared with records of 2 to 5 per cent during the years 1918 to 1925. Streets states that stripe does not thrive under the dry climatic conditions of Arizona. Vaughan of Wisconsin reports that delayed seeding gives less stripe but also less favorable conditions for barley development.

Barley-Stripe:Spot Blotch

Experiments on the temperature and moisture relations of barley stripe were conducted at the Wisconsin Station, with results reported by Dickson (1), as follows:

> "The experiments upon barley stripe have shown that seeding very early in a wet, cold soil increases the losses from barley stripe. The barley plants develop best and give the highest yield when seeded in a moderately cool soil, about 55°F. The later seedings in a warm, dryer soil are in general more free from the stripe disease but yields are greatly reduced due to the late seeding. A safe compromise can be used inseeding barley later than wheat and oats when the soil is still cool and moist by treating the seed for the control of stripe."

The following notes concerning varietal susceptibility have been sent in by collaborators. Very resistant, Lion in Minnesota; slightly resistant, Trebi in Colorado; and susceptible, Minsturdi and Svansota in Minnesota and Colsess in Colorado.

For control see section on seed treatment, pages 111 and 112.

Recent literature:

1. Dickson, J. G. Making weather to order for the study of grain diseases. Wisconsin Agr. Exp. Sta. Bul. 379: 3-36. 1926.

2. Hann, K. de. Onderzoek over de streponziekta van de gerst en de verwekker Helminthosporium gramineum Rab. Tijdschr. Plantenz. 32: 45-56. Feb. 1926. English summary (Investigations on the stripe disease of barley): 55-56.

SPOT BLOTCH CAUSED BY HELMINTHOSPORIUM SATIVUM PAM., KING, AND BAK.

Spot blotch is most commonly reported from all of the Middle West and the Pacific Coast States. It is of minor importance, seldom causing over a trace of loss in any section of the country. Losses reported in 1926 were 1 per cent from Pennsylvania and Minnesota, .5 per cent from New York, and a trace from Maryland, Virginia, Wisconsin, Iowa, South Dakota, and Montana. In California, spot blotch caused the heaviest damage on record, according to Mackie. Maximum percentages of infection reported were 100 in Iowa and California and 30 in Pennsylvania.

NET BLOTCH CAUSED BY PYRENOPHORA TERES.(DIED) DRECHS.

Net blotch occurs widely but appears to be of very minor importance except possibly in Iowa, South Dakota, and Wisconsin. In the former state it caused losses averaging nearly 5 per cent from 1919 to 1925, but in the two others the loss during the same period was only about one-seventh of that in Iowa. Reports from twenty collaborators indicate that net blotch caused less damage in 1926 than in either 1925 or an average year. In Iowa, Gilman reports only a trace of loss. In California, on the other hand, the disease was more important than usual. All fields throughout the state were affected, some as much as 100 per cent, according to Mackie.

RUSTY BLOTCH CAUSED BY HELMINTHOSPORIUM CALIFORNICUM MACKIE AND PAXTON

Rusty blotch of barley has been reported only from California where it seems to be of moderate economic importance. In 1926 it was reported as causing the heaviest damage on record.

Concerning varietal susceptibility, W. W. Mackie reported that:

> "All varieties of barley were more or less badly infected with Helminthosporium californicum. Only one variety was found to be immune to this disease. Of the varieties in the replicated plat experiment, Smooth Awn barley, No. 1367, is highly resistant; it promises also to be one of the highest yielding varieties."

SCALD CAUSED BY RHYNCHOSPORIUM SECALIS (OUD.) DAVIS

Judging from the reports of collaborators barley scald seems to be confined almost entirely to the states in the Pacific Coast Region and to those in the Middle West. It is apparently of minor importance except on the Pacific Coast, where in some years, it is the most destructive barley disease.

In 1926 there was less scald than in 1925 or in an average year. Of the collaborators reporting from 26 states only three, from Wisconsin, Washington, and California, reported having found scald. In each case the loss was a trace. In California, Mackie states, "Attacks of barley scald are much lighter this year than any of the past five years, probably due to the very dry foggy period during midwinter."

SCAB CAUSED BY GIBBERELLA SAUBINETII (MONT.) SACC.

Scab on barley is commonly reported from the Middle West and Middle Atlantic States. Outside of this area it is seldom found. It is of little economic importance except possibly in Iowa where it causes an appreciable loss about one year out of three, and where the loss during the past eight years has averaged about 1 per cent.

During 1926 reports indicate that scab was even less important than usual as only five or six states, New York, Pennsylvania, Maryland, Wisconsin, Iowa, and North Dakota, reported even a trace.

ERGOT CAUSED BY CLAVICEPS PURPUREA (FR.) TUL.

Ergot is of no economic importance on barley since only very rarely are more than a few infected heads observed in any one field. In 1926 traces were reported from Indiana, Wisconsin, and North Dakota. Vaughan stated that the beardless barley is very susceptible under Wisconsin conditions.

ANTHRACNOSE CAUSED BY COLLETOTRICHUM GRAMINICOLUM (CES.) WILS.

Anthracnose is almost entirely confined to the northeastern quarter of the United States. Outside of this area it has been reported from Alabama, Louisiana, and Texas. On barley, it is a disease of almost no economic importance, only one collaborator having reported a loss of over a trace since 1918. In 1926 it was reported only from Pennsylvania where a few infected plants were found in a barley field August 2.

POWDERY MILDEW CAUSED BY ERYSIPHE GRAMINIS DC.

Powdery mildew is most often reported from the northeastern quarter of the United States. It has also been reported from several states in the Pacific Northwest and from Texas and California. Normally it is of very slight importance.

Losses reported in 1926 were 5 per cent in California, 1 per cent in Arizona, one-half of one per cent in Pennsylvania, and a trace in Connecticut and Oregon. In Arizona, Streets reported that powdery mildew was prevalent in Yuma County and quite severe on the later plantings, but was not abundant in Maricopa or other southern counties. It was aggravated by cool, wet weather in March and April.

Barley - Other Diseases.
Oats - Loose and Covered Smuts.

OTHER DISEASES

Bacterium translucens Jones, Johnson & Reddy, bacterial blight. Texas, a trace.

Fusarium sp., pink rot. Mackie stated that in California this disease caused considerable damage causing plants to blight at all stages of development.

Hormodendrum cladosporioides Sacc., sooty mold. California, slight injury.

Puccinia glumarum (Schw.) Eriks. & Henn., stripe rust. On July 1, Nita, a Japanese variety, was found to be badly affected with stripe rust at Pullman, Washington. Other varieties growing in the same plots had from slight to no infection.

O A T S

DISEASES OF OATS

The percentage of loss to the oat crop from disease has varied from 4.8 to 8.6, from 1918 to 1925, the smallest loss occurring in 1920 and the largest in 1921.

The diseases in order of importance are loose and covered smuts, 2.99 per cent average loss, stem rust 0.99 per cent, crown rust 0.91 per cent. The average loss from all diseases during the period is 7.51 per cent.

LOOSE AND COVERED SMUTS OF OATS CAUSED BY USTILAGO AVENAE (PERS.) JENS. AND U. LEVIS (KELL. & SW.) MAGN.

Oat smuts are present in every section of the country where oats are grown. The highest losses seem to be, in general, east of the Rocky Mountains and especially south of the Mason-Dixon Line. The loss due to the two smuts of oats is greater than that caused by any other single disease attacking oats and represents on the average about 40 per cent of the total loss to the oat crop from disease.

In 1926 reports from collaborators in 38 states indicate that oat smuts caused a slightly greater loss than in 1925, or in the average year. Six states, New York, Pennsylvania, Georgia, South Carolina, Nebraska, and Tennessee reported the highest losses recorded in the plant disease survey records while five reported less loss in 1926 than in 1925. The maximum percentages of infection in single fields were reported as follows: Missouri and Georgia, 50; New York, 40; Minnesota, 35; Arizona and South Carolina,

25; North Carolina, Colorado, and California 20; Pennsylvania, 19. The estimates of losses are listed in Table 41.

Table 41. Estimated reduction in yield of oats due to loose and covered smuts for 1926 and (in parentheses) for the period 1918 to 1925, as estimated by collaborators.

Percentage loss	States reporting	Percentage loss	States reporting
11.0	Georgia (5.)		Maryland (3.3)
10.0	South Carolina (5.)	2.6	North Carolina (4.27)
8.0	Pennsylvania (3.8)	2.5	Mississippi (3.28)
	Massachusetts (3.07)	2.0	Arizona (1.6)
6.0	Nebraska		North Dakota (2.36)
5.0	South Dakota (2.08)		Connecticut (2.5)
	Minnesota (1.6) Iowa (2.2)	1.5	Colorado (.188)
	New York (3.6)		Idaho (2.7)
4.0	Montana (3.16)		New Jersey (2.35)
	Missouri (3.4)		Oregon (1.)
	Arkansas (8.8)	1.0	Texas (4.8)
	Michigan (2.68)		Florida (1.3)
	Virginia (4.6)		West Virginia (2.8)
3.0	Wisconsin (1.6)	0.5	Washington (1.37)
	Illinois (5.07) Ohio (2.5)		Kansas

In Pennsylvania, Kirby reports that: "The 1926 loss, which was the largest on record, was apparently due to farmers planting their oats unusually late when the ground was warm and fairly dry, and to lack of seed treatment." In South Carolina, according to Ludwig: "In a few cases crops of volunteer winter oats were entirely free of smut while the same seed when planted at the normal time in the fall produced a badly smutted crop." In Kansas, D. D. Hill, (Cereal Courier 18: 225, 1926) states that: "Smut infection is the lowest it has been for several years owing to climatic conditions unfavorable for the development of the smut fungus."

The weather prevailing while the oats germinate and emerge from the soil is reported as determining the amount of smut in the resulting crop. Dickson (1) states that spring weather conditions largely control the development of oat smut and determine not only the regions in which oats are generally smutted but the amount of smut developing from year to year within these regions. On the basis of planting experiments he recommends planting oats early in the spring in moist soil to avoid smut.

Considerable difference apparently exists in the susceptibility of various oats to smut. The following have been reported this year.

Varieties immune: Black Mesdag and Markton in Minnesota.

Varieties very resistant: Kanota in California and Kansas. Concerning Kanota, L. E. Melchers states that it is a Fulghum oat which has shown marked resistance to both smuts and that seed treatment is not necessary for this variety. In 1926, 50 per cent of Kansas oat acreage was planted to this variety, and 75 per cent will be planted to it in 1927. Fulghum in California and Missouri.

Varieties susceptible: Jeanette in Minnesota; Swedish Select and Silvermine in Pennsylvania.

Varieties very susceptible: White Russian in Minnesota, most hulless varieties.

Following are some of the comments of collaborators regarding control. (See also section on seed treatment at beginning of this summary).

Maine: Oat smut present in fields planted with untreated seed. (Folsom).

Pennsylvania: Dry formaldehyde treatment only one used. In the fifty fields surveyed there was an average of 8.56 smut in the untreated in comparison with less than one-tenth of one per cent in the treated. (Kirby).

Ohio: Increasing attention given to seed treatment and to the securing of seed free from smut is gradually reducing this disease. (Thomas).

Wisconsin: Formaldehyde treatment was effective when used. (Vaughan).

Colorado: Recommends sprinkling method using 1 pint formalin to 40 gallons of water. (Durrell).

Idaho: Recommends Idaho modification of concentrated formalin treatment (1 part formalin to 10 parts water.) Used extensively with absolute control. (Hungerford).

W. H. Tisdale (7) writes that copper carbonate dust prevents smut of hulless oats, but is less effective on hulled varieties.

Recent literature:

1. Dickson, James G. Making weather to order for the study of grain diseases. Wisconsin Agr. Exp. Sta. Bul 379: 3-36. Jan. 1926.

2. Reed, G. M. Plant pathology. Disease resistance. Fifteenth Ann. Rept. Brooklyn Bot. Gard., 1925, pp. 55-57. 1926.
A few of the numerous smut collections from various regions indicate the existence of distinct new races definitely limited to certain varieties.

3. Rösch, A. Studien über den Haferflugbrand, Ustilago avenae (Pers.) Jens. und den Glatthaferbrand, Ustilago perennans Rostr., mit besonderer Berucksichtigung der Immunitatsfrage beim Haferflugbrand. Bot. Arch. 13: 382-431. 1926.
Study confirms previous investigations in that the spores of loose smut germinate on the open blossoms, and form resting mycellium and gemmae which in turn may resume growth and infect the seedlings in the spring.

4. Tisdale, W. H. Present status of the copper carbonate seed treatment. U. S. Dept. Agr. Office Coop. Ext. Work Extension Pathologist (mimeogr.) 4: 14-16. May, 1926.

STEM RUST CAUSED BY PUCCINIA GRAMINIS PERS.

Stem rust is present in all sections of the United States. It is most prevalent in the upper middle western states where it is one of the most destructive oat diseases. In the other sections of the country, with the exception of four or five scattered states, it is of minor importance.

In 1926 there occurred one of the most severe epiphytotics of oat stem rust on record, the loss being several times greater than that recorded for any other year. The percentage losses reported are given in table 42. In Illinois, Tehon stated that this was the most serious rust epidemic experienced in this state in 40 years. In Iowa, S. M. Dietz reports the most stem rust since 1917. In California Mackie reported 100 per cent infection as general and estimated a 25 per cent loss from this disease, and stated that stem rust caused a complete loss in whole areas in southern California. Indiana, Wisconsin, and Minnesota each report a larger loss than any recorded since 1918. The following graph (Fig.17) shows that in the barberry eradication area the 1926 loss was the largest since 1919.

Table 42. Percentage losses from stem rust on oats, as estimated by collaborators, 1926, and the average loss 1919 to 1925.

Estimated percentage loss 1926	States reporting	Average percentage loss 1919-1925	Estimated percentage loss 1926	States reporting	Average percentage loss 1919-1925
15.	Ill.	.08	0.1	Ohio	.52
10	Minn.	1.64	0.1	Oreg.	
10	Iowa	1.45	Trace	Md.	Tr.
10	Calif.	3.2	"	W. Va.	Tr.
7.5	Mich.	3.7	"	Ga.	1.
3.5	Wis.	.78	"	Mo.	Tr.
3.5	S. Dak.	4.8	"	Neb.	.75
3.	Mass.	.4	"	Kans.	Tr.
1.13	N. Dak.	3.08	"	Ark.	.4
1.	Pa.	.5	"	Mont.	Tr.
1.	Ind.	tr.	"	Colo.	.4
0.5	Conn.		"	Wyo.	Tr.
0.5	Ariz.		"	Wash.	Tr.
			Present, unknown	Tex.	1.18

Oats - Stem rust

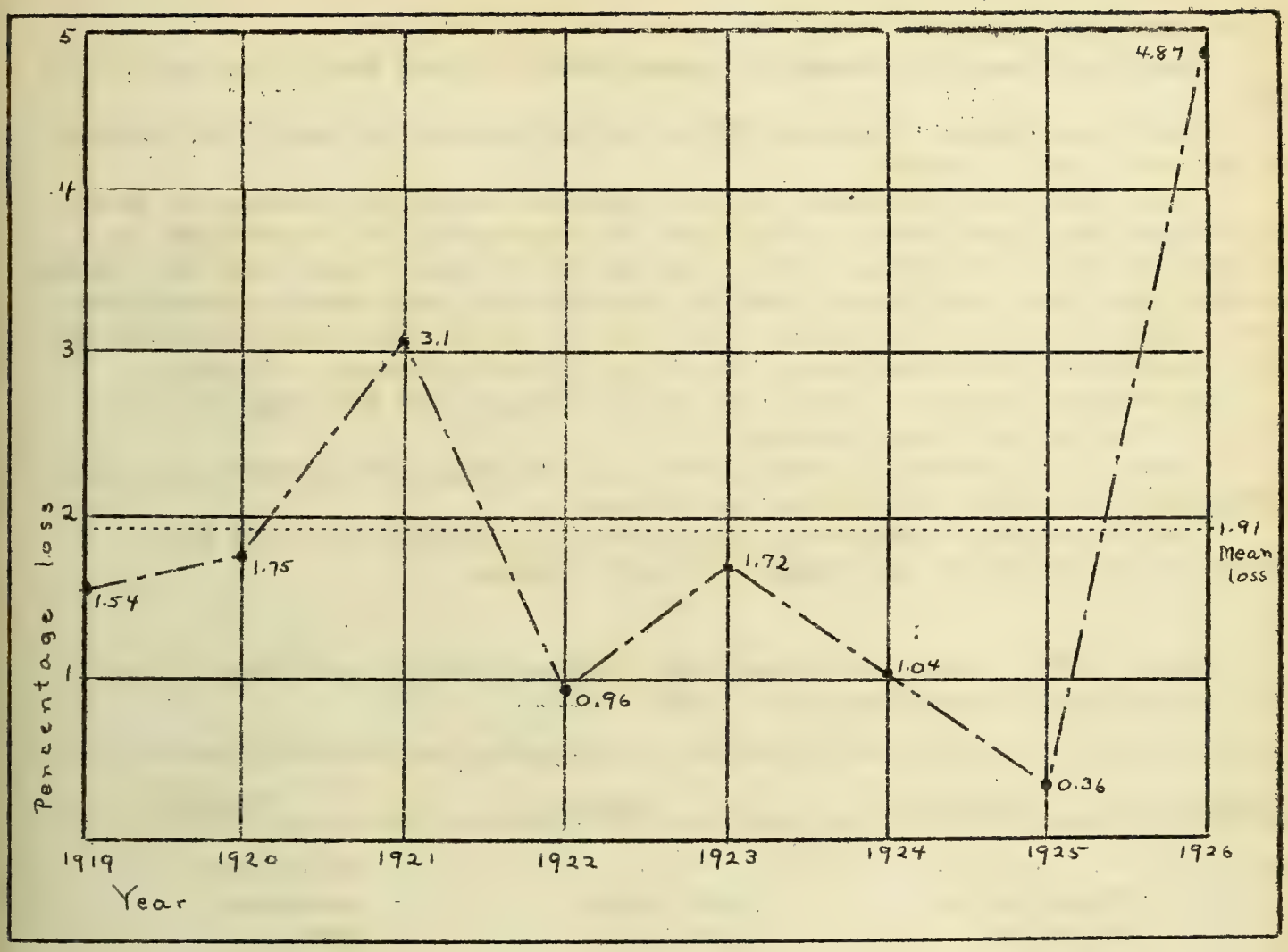

Fig. 17 Estimated average percentage loss in oats from stem rust in the 13 barberry eradication states from 1919 to 1926.

The 1926 epidemic of stem rust on oats in certain of the middle western states may have been due to a combination of weather conditions. The rainfall during April and May was considerably below normal throughout this region. This resulted, as described by Nelson and Reddy for Michigan, in late planting and delayed maturity, thus prolonging the period of susceptibility. The long dry spells in certain states, such as Iowa, Illinois, and North Dakota, were broken during the last of May, June 16 and 17 and July 9 and 10, by short rainy periods favorable to rust infection. In contrast, the weather was continuously dry in Missouri, Kansas, Nebraska, and Montana, and held the rust in check so that it caused little or nor loss. Iowa and North Dakota reported the largest losses in the later maturing oats.

As to the source of infection, several states, including Pennsylvania, Wisconsin, Illinois and South Dakota report greatest loss in the vicinity of escaped barberry bushes. J. W. Baringer, (Cereal Courier 18: 267. 1926.) states that in Ohio the relation between the existence of barberry and the occurrence of severe infection on oats was not clear in many cases, and R. E. Vaughan reports that in northern Wisconsin the rust appeared to result

from wind-blown spores.

The following differences in susceptibility have been reported during 1926.

Varieties immune: Richland 320 a in California, as usual, is entirely free of stem rust. - Mackie.

Varieties very resistant: Hybrid Richland and Green Russian in Iowa, and Richland in Pennsylvania. Richland, on account of its resistance to the forms of stem rust present in Pennsylvania at the present time is rapidly replacing the other varieties grown in the northern part where escaped barberry bushes in many cases enable stem rust to almost completely destroy the common varieties like Silvermine, Cornellian, and Patterson. - Kirby.

Varieties resistant: Richland, Green Russian and Iowa 444 in Iowa and Green Russian in Pennsylvania.

Varieties susceptible: Cornellian and Patterson in Pennsylvania, and 60-Day, Swedish Select and Gopher in Minnesota.

Varieties very susceptible: Silvermine in Pennsylvania and Iowa, Victory in Pennsylvania and Gopher in North Dakota.

Table 43. Dates and places of first observation of stem rust on oats, as reported by collaborators. 1926.

Date	Place	County	State
April	- - -	- - -	California
May 30	Fayetteville	Washington	Arkansas
June 6	Humboldt	Humboldt	Iowa
June 9	Wells	Faribault	Minnesota
June 12	Union	Franklin	Missouri
June 23	Edwardsville	Madison	Illinois
June 29	Glenhaven	Grant	Wisconsin
July 6	- - -	Gutrim	Michigan
July 12	Fargo	Cass	North Dakota
July 15	Fort Collins	Larimer	Colorado
July 27	Franklin	Venango	Pennsylvania

Stem rust on oats can apparently pass the winter in the uredinial stage in the Gulf Coast States and California.

CROWN RUST CAUSED BY PUCCINIA CORONATA CDA.

Crown rust has been reported in the past from all sections of the United States, with the possible exception of three of the Southern Rocky Mountain States. This rust is most prevalent in the Cotton Belt States, where it and oat smuts are the most destructive diseases. North of these states it becomes of moderate importance and in the West, with the possible exception of California, it is a very minor trouble.

Some of the collaborators' reports on prevalence are:

Oats - Crown Rust

New York: More than last year with some late planted fields having considerable. (Barrus).

Pennsylvania: Much less than in 1925. Trace found in about 2 per cent of the oat fields. (Kirby).

South Carolina: Less than last year. (Ludwig).

Mississippi: More than last and average years. (Neal).

Louisiana: Present in normal amounts. (Tims).

Texas: Unusually prevalent. (Taubenhaus).

Arkansas: Common and more prevalent than last year, but not as serious as in average years. (Rosen).

Illinois: Less than last year. (Tehon).

Minnesota: Much less than last year. (Sect. Plant Path.)

Iowa: Less than last year. (Dietz).

Kansas: Practically absent. (Melchers).

Nebraska: Rare to trace. (Peltier).

Oregon: Unusually severe in Coast Regions (Barss).

California: Very prevalent this year, much more so than usual, but not doing very much damage. (Mackie).

The largest loss from crown rust in 1926 occurred in the West Gulf Coast State, and in California; New York, and Wisconsin. (See Table 44).

The abnormally small loss caused by crown rust is attributed by at least seven collaborators to the exceptionally dry spring which retarded the development of the rust. Excess rainfall is given as a cause for the increased amount of rust in Louisiana, where precipitation was 1.81 inches above normal in April, and 1.06 inches above normal in May, and the loss from crown rust was more than twice the average for the previous eight years.

This rust was first observed on January 11, in Louisiana; February 4, at Gainesville, Florida; in April in California; April 30, at Kane Island, Beaufort County, North Carolina; May, in southern Iowa; May 30, at Fayetteville, Arkansas; June 2, at Marshall, Illinois, and June 18, at Red Wing, Minnesota.

Several reports have been sent in concerning the difference in susceptibility of oat varieties to the crown rust. Texas Rust Proof is reported by Tims in Louisiana, and the Department of Plant Pathology in Arkansas as being resistant. Richland shows fair resistance in Pennsylvania, while Richland 320 in California showed considerable infection according to W. W. Mackie.

Table 44. Estimated reduction in yield of oats due to crown rust for 1926 and (in parentheses) for the period 1918 to 1925, as estimated by collaborators.

Percentage loss	States reporting	Percentage loss	States reporting
20.0	Louisiana (8.7)	Trace	North Dakota (1.66)
2.0	Texas (6.75)		Minnesota (.15) Iowa (.71)
	New York (1.)		Arkansas (5.7)
1.5	Mississippi (4.14)		Michigan (1) Ohio (.58)
	California (.8)		West Virginia (.66)
.7	Wisconsin		Maryland,
.5	Connecticut (.8)		Pennsylvania (.75)
.2	Illinois (1.7)		New Jersey (.76)
Trace	Oregon,		Massachusetts (.4)
	South Dakota (.83)		Arizona

Oats - Crown Rust: Blast: Halo Blight.

Recent literature:

1. Davies, D. W. and E. T. Jones. Studies in the inheritance of resistance and susceptibility to crown rust. (P. coronata corda) in a cross between selections of Red Rustproof (A. sterilis L.) and Scotch Potato (A. sativa L.). Welsh Jour. Agr. 2: 212-221. 1926.

2. Dietz, S. M. Alternate hosts of Puccinia coronata. II. - Abs. in Phytopath., 16: 84. 1926.

3. Popp, W. Crown rust of oats in eastern Canada. Ann. Rep. Quebec Soc. Prot. Plants. 18: 38-54. 1926.

BLAST (NON-PAR.)

In 1926 there was apparently about the same amount of blast as in 1925, with four states, Pennsylvania, Wisconsin, California, and Illinois, reporting more, and the same number, Arkansas, Tennessee, Nebraska, and South Dakota reporting less. The dry weather again caused the amount of blast to be considerably higher than normal. In several sections blast must be considered as a very important trouble since it has been reported to cause almost as much loss as the smuts or rusts. This year it caused a greater loss in Kansas and Montana than any other disease.

Loss estimates for 1926 were submitted as follows: 10 per cent in California; 3 to 15 per cent in Montana; 7 per cent in Iowa; 5 per cent in Illinois, Minnesota, and Kansas; 1.5 per cent in Pennsylvania; 1 per cent in New York and Mississippi; and a trace in Maryland, Arkansas, Wisconsin, South Dakota, North Dakota, and Colorado.

HALO BLIGHT CAUSED BY BACTERIUM CORONAFACIENS ELLIOTT.

Halo blight has been reported to the Plant Disease Survey from twenty-nine states. It occurs commonly in most of the Middle Western and Middle Atlantic States and California. In most of the southern and western states it is rarely, if ever, observed. It is a disease of minor importance, usually causing only a trace of loss. It is most severe in the five principal oat growing states, where as high as one per cent loss has been reported. There seems to have been very little change in its severity during the past three years.

In 1926 collaborators in sixteen states reported the presence of halo blight but in no case was the loss said to be over 0.1 per cent.

In Wisconsin, R. E. Vaughan reports that maximum injury was to seedlings and that the early rains and cool weather favored the development of the disease. In Missouri, W. A. Archer observed that the infection appeared immediately after the end of a long drought and that the variety Fulghum was susceptible.

SCAB CAUSED BY GIBBERELLA SAUBINETII (MONT.) SACC.

During the past twenty-two years scab on oats has been reported to the Plant Disease Survey from sixteen states, viz., California, Texas, and fourteen states in the Northeastern part of the country. It is of minor importance, seldom causing over a trace of loss in any individual state. In 1926 traces were reported from Pennsylvania, Maryland, Wisconsin, Minnesota, and Iowa.

ANTHRACNOSE CAUSED BY COLLETOTRICHUM GRAMINICOLUM (CES.) WILS.

Anthracnose has been reported from seventeen states scattered throughout the central, southern and eastern sections of the United States. It has been most prevalent in the states bordering on the Great Lakes and Gulf of Mexico. Losses greater than a trace (less than 0.1 per cent) are very rarely reported. In 1926 it was reported from Pennsylvania, Ohio, Mississippi, and Wisconsin. Dry weather likely held it in check. In Pennsylvania, Ohio, and Wisconsin, only a few infected plants were observed. In Mississippi, where weather conditions were normal, a loss of two per cent was reported by D. C. Neal.

OTHER DISEASES

Erysiphe graminis DC., powdery mildew. This disease, of minor importance, has been reported most commonly from the Pacific Coast States. In 1926 it was reported as causing a trace of loss in Washington, by the Department of Plant Pathology, and in Oregon, H. P. Barss reported that considerable development of mildew was noted during the spring in the Williamette Valley.

Fusarium sp., pink rot. Common throughout California, 1 per cent loss. (Mackie).

Helminthosporium sp., probably H. avenae Eidam, leaf spot. Pennsylvania, South Carolina and California. In South Carolina, D. B. Rosenkrans stated that "About April 26 leafspot was largely prevalent in river bottoms but not so much on upland." In California, W. W. Mackie reported on May 25 that "Leaf spot has been noted in a number of areas in the Sacramento Valley, but it is rare and causing but little damage." In Pennsylvania, it was observed on June 4 to be very common, but was causing only a slight damage.

Macrosporium sp. sooty mold. Specimens of this were collected in Montana, by P. A. Young. In Pennsylvania, continued rains during harvest caused a loss of at leat 10 per cent by allowing the oats to become severely molded, and to sprout in the shock. (R. S. Kirby).

Pseudomonas sp., bacterial leaf blotch. Arkansas, reported on April 1, at Fayetteville, "The bacterial disease of oats, reported to the Survey last year, in which spots and streaks are not surrounded by halos, has been found in great abundance this spring, on spring oats. Winter oats on the other hand show very few spots." (Rosen).

In Manitoba, Canada, G. R. Bisby reports that "A bacterial leaf spot of oats is very prevalent. It is much more common than halo-blight. Specimens were submitted to H. R. Rosen, who finds that the disease is similar to, or identical with, the bacterial blotch he has found in Arkansas."

Sclerotium rolfsii Sacc., southern blight. This disease has been reported only from Arkansas and Mississippi. In 1926 it was reported from Mississippi where D. C. Neal states that "Southern blight of oats was very prevalent in the oat nursery here this spring. There was at least 20 or 25 per cent of Sclerotium rolfsii on many of these oat varieties. There does not seem to be any difference in varietal susceptibility so far as I have been able to tell."

Recent literature:

1. Anon. Arkansas Diseases. Arkansas Sta. Bul. 203: 44-51. 1926.

2. Anon. M. A. Die Anwendung von Kupfervitriol gegen die Heide-moorkrankheit. Deut. Landw. Presse 53: 156. Mar. 27, 1926.

3. Hiltner, E. Hafer-Dorrfleckenkrankheit und Hederich Bekämpfung. Illus. Landw. Zeit. 46 (15): 188-190. Apr. 9, 1926.

4. Tacke, B. Neue Erfahrungen über Heidemoorkrankheit. Deut. Landw. Presse 52: 16. Jan. 9, 1926.

C O R N

SMUT CAUSED BY USTILAGO ZEAE (BECKM.) UNG.

Corn smut has been reported from every state. It is one of the most important diseases of this crop and has been estimated to cause a total reduction in yield varying in different years from 1.6 to 3.1 per cent. The map showing distribution of corn smut, 1918 - 1926, (Fig. 18) gives the average of the estimated annual losses from this smut in the different states.

In 1926 there apparently occurred an epiphytotic of this disease which resulted in one of the largest losses on record. Fourteen reported that corn smut was more prevalent in 1926 than in 1925, twelve that there was about the same amount, and only three, Georgia, Kansas, and Minnesota, reported less. Losses for 1926 are given in table 45 .

Corn - Smut

The following reports of collaborators are of interest:

New Jersey: Throughout central and southern Jersey corn smut is more prevalent than it has been for the past five years. (Dept. Plant. Path.)

Pennsylvania: Caused a larger loss in 1926 than previously recorded. (Kirby).

South Carolina: Was much more severe than usual. (Ludwig).

Arkansas: More corn smut noticed this year, on late maturing varieties, than in eight years previously. (Rosen).

Iowa: General throughout the state, showing more prevalence in central and southern Iowa; 5 per cent loss. (Burns).

South Dakota: An unusual amount of corn smut was noted this year, from 30 to 50 per cent of ears being affected as well as other plant parts. (Brenckle).

Kansas: Less than usual. It is believed the excessive drought in many places in Kansas reduced the vegetative growth of the corn to an extent which prevented considerable infection. (Melchers).

In general smut was reported as becoming severe later than usual, and late corn was usually more severely injured than the early maturing corn. The general increase in severity in most sections of the country was apparently correlated with weather conditions, as shown in table 46. In most of the states where August precipitation was above normal there was more smut than usual. On the other hand, in a few states, as Kansas and South Dakota, where rainfall was less than normal, there was also less corn smut. This appears to be particularly significant when these extremes are reported from neighboring states as North and South Dakota, Iowa, and Kansas. Fromme and Godkin reported that in Virginia, "Corn smut was especially prevalent in sections where rainfall was plentiful." In both Arkansas and Pennsylvania, corn smut was almost absent until the abnormally rainy period started, according to collaborators.

The conditions occurring in 1926 agreed closely with the findings of Coffman, Tisdale, and Brandon (1), during three years' investigations at the United States Dry Land Field Station, Akron, Colorado, that the percentage of smut varied in different seasons, according to the weather, summarized as follows:

> "Scant precipitation in May and June followed by moderate rainfall and comparatively high temperatures seemed to favor the disease. Such conditions prevailed in 1921, Moderate amounts of precipitation throughout the season accompanied by high temperatures in July and August seemed to favor moderately abundant infection. Such a result was obtained in 1922. A rather heavy precipitation in the early part of the season followed by scant rainfall and low temperatures in the later summer was not conducive to heavy infection. The greater part of the smut appeared in July and August in all years."

Regarding the influence of temperature on smut infection, Vaughan of Wisconsin stated that corn smut is rarely seen until the temperature gets above 70°F.

Sweet corn was reported to be much more susceptible to smut than field

corn, by collaborators in Connecticut, New York, Delaware, Ohio, Michigan, South Dakota, and Colorado. The heterogeneous nature of corn largely precludes comparing the susceptibility of the common varieties as they occur in most sections. The Minnesota Section of Plant Pathology reported considerable variation in pure lines of both field and sweet corn at the University Farms.

Coffman, Tisdale, and Brandon (1) report that in their investigations in Colorado:

> "Varietal differences in susceptibility of corn to smut were found. Strains selected for smut resistance consistently showed lower percentages of smut. Strains of Swadley corn grown during 1920 to 1922, inclusive, showed marked differences in degree of smut susceptibility. Although variation from year to year occurred in a given strain, some strains produced consistently less smut than others. Ear-row progenies from the same parent ear-row in some cases showed marked differences in degree of smut susceptibility, while in other cases they were very similar, all strains showing either high or low percentages of smut. This may prove of some practical value in breeding smut-resistant strains of corn."

Griffiths (2) reports that the resistance of highly resistant strains of corn in the field appears due merely to the fact that inoculum does not reach the young growing tissue.

Table 45 . Percentage losses from smut of corn as estimated by collaborators, 1926. (Maximum percentage field infection in parentheses.)

Percentage loss	States reporting	Percentage loss	States reporting
15.	South Carolina (36.)	1.	Massachusetts,
10.	California (90.)		Delaware,
5.5	Pennsylvania (25.)		West Virginia
5.	Tennessee,		Texas
	Iowa		South Dakota (70.)
	North Dakota (15.)		Minnesota (70.)
4.	Arizona		Colorado (10.)
3.5	North Carolina (20.)	0.5	Mississippi (1.)
3.	Connecticut,		Indiana (60.)
	Arkansas,		Wisconsin
	Kansas,		New York
	Michigan (25.)	0.1	Alabama
	Missouri (30.)	Trace	Maine,
2.5	New Jersey		Idaho
2.	Virginia,		Washington
	Ohio		Montana, Florida (10)
1.5	Maryland		Louisiana.

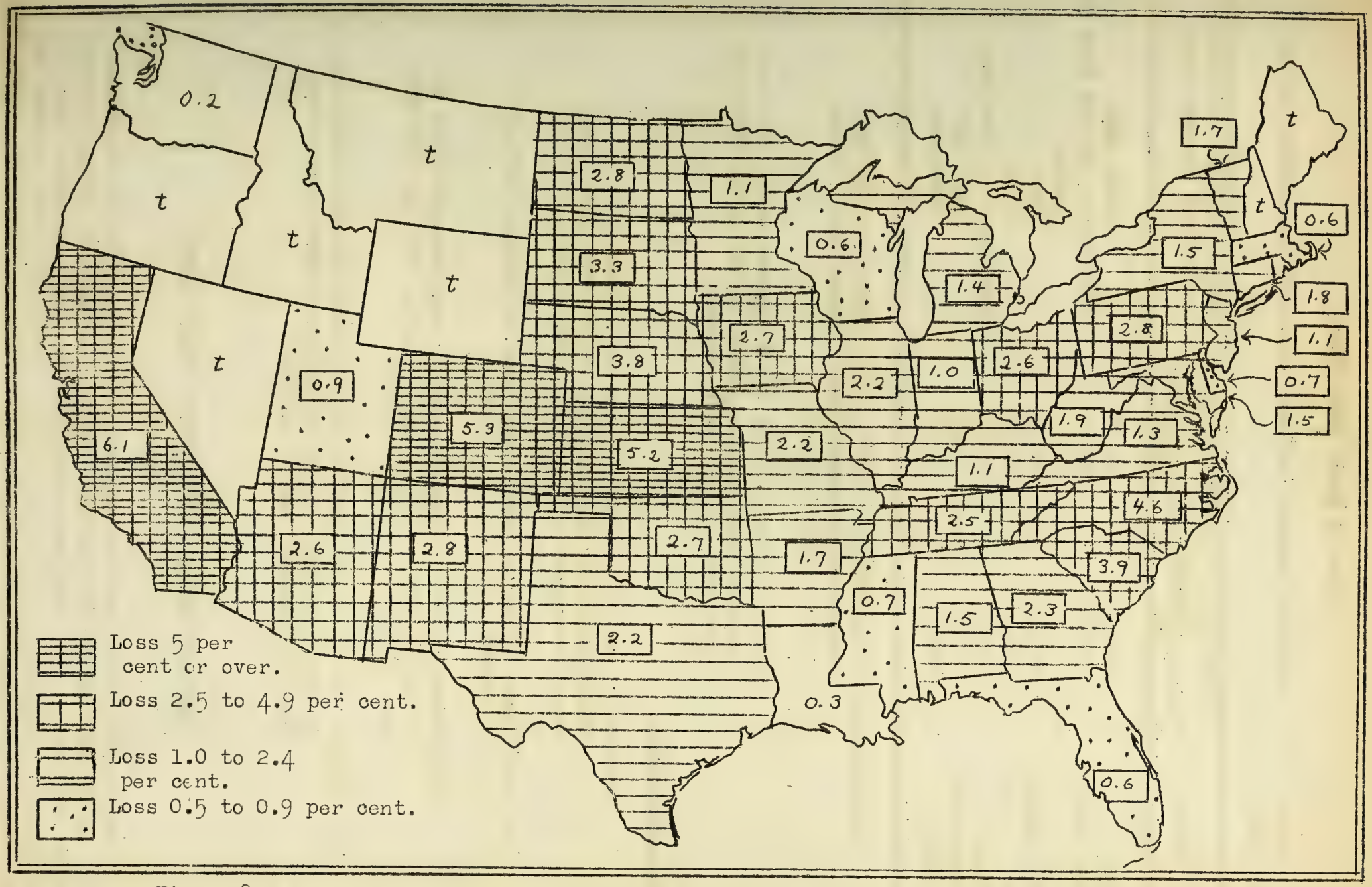

Fig. 18 Average annual percentage loss from corn smut, 1918 to 1926.

Table 46. Relation between weather conditions and amount of corn smut, 1926.

State	Departure of precipitation from normal		Amount of corn smut compared with average year.
	July	August	
Kansas	-0.94	-0.22	Much less
South Dakota	+0.01	-0.12	Same as in 1925 or less than normal
North Dakota	-0.61	+0.15	More
Iowa	-0.13	+0.36	More
Arkansas	-0.27	+1.81	Much more in late corn
Pennsylvania	-0.52	+1.46	Much more
Tennessee	+0.19	+3.98	Much more

Temperature: In August, 1 to 2.8°F. above normal in all the above states except South Dakota where it was 0.2°F. above normal.

In July it was 0.1 to 0.7°F. below normal in Pennsylvania and Arkansas while in the other states it was 0.6 to 2.8°F. above normal.

Recent literature:

1. Coffman, F. A., W. H. Tisdale, and J. F. Brandon. Observations on corn smut at Akron, Colorado. Jour. Amer. Soc. Agron. 18: 403-411. May, 1926.

2. Griffiths, Marion A. Smut resistance in Corn. (Abstract). Phytopath. 17: 42. Jan. 1927.

3. Hurd-Karrer, A. M. Effect of smut on sap concentration in infected corn stalks. Amer. Journ. Bot. 13: 286-290. May, 1926.

4. Tisdale, W. H. & Johnston, C. O. A study of smut resistance in corn seedlings grown in the greenhouse. Journ. Agr. Res. 32: 649-668. April 1, 1926.

LEAF RUST CAUSED BY PUCCINIA SORGHI SCHW.

Leaf rust of corn has been reported from all parts of the United States except some of the far western states. In general it is a disease of minor importance. In 1926 North Carolina was the only state reporting an increase in prevalence. Only four states report more than a trace of loss, viz., Mississippi 2 per cent, North Carolina and Louisiana 1 per cent,

and Indiana 0.5 per cent.

In Wisconsin, according to Vaughan, "The aecial stage was found to be very abundant on Oxalis sp., under natural conditions."

DRY ROT CAUSED BY DIPLODIA ZEAE LÉV.

Dry rot has been reported from nearly all of the states east of the Rocky Mountains, and from California and Washington. It is one of the most destructive corn diseases in the central and southeastern parts of the United States, where losses of from two to five, or even ten per cent are often reported. Further north, where the weather is cooler, in New York, Pennsylvania, Michigan, Wisconsin, Minnesota, the Dakotas, and the dry western states, the loss is usually slight and the disease is of minor importance.

Nineteen twenty-six was reported by collaborators as being an epiphytotic year for Diplodia. Of the fifteen states reporting on its relative prevalence seven reported the disease as more or very much more severe in 1926 than in 1925 or than usual and no report indicates less loss than in 1925. The estimates of losses are given in Table 47 . This epiphytotic of Diplodia apparently was due to the abnormally wet, warm weather, which occurred in nearly all states where the disease was severe.

In Delaware, Adams reported that, "Infestation by corn ear worm appears to have favored much Diplodia ear rot infection."

Recent literature:

1. Jehle, R. A., F. W. Oldenburg, and C. E. Temple. Relation of internal cob discoloration to yield of corn. Phytopath. 16: 207-215. 1926.

2. Tryon, H. Ear rot of maize. (Diplodia zeae (Schwein.) Lev.) Queensland Agr. Journ. 25: 237-258. March, 1926.

Table 47 . Percentage loss from Diplodia dry rot of corn as estimated by Collaborators, 1926.

Percentage loss	States reporting	Percentage loss	States reporting
8.55	Illinois	2.	North Carolina, Kansas
6.	Iowa	1.5	Mississippi
5.	Arkansas, Ohio	1.	Delaware, Virginia
4.	Maryland		South Dakota
3.5	Indiana	.8	Pennsylvania
3.	Michigan	Trace	Massachusetts, Wisconsin

ROOT AND STALK ROTS CAUSED BY GIBBERELLA SPP. AND FUSARIUM SP.

Root and stalk rots have been reported from practically every state except some of those in the Far West. In 1926 it was apparently slightly more prevalent than in 1925. More than the average was reported from New Jersey, Maryland, Tennessee, Indiana, and Wisconsin and less from Delaware, Virginia, Kentucky, and Illinois. The following are some of the reports received from collaborators:-

Virginia: Especially severe in Loudoun, Fairfax, and Fauquier Counties; accompanied by deficiency in one of more of the essential elements. (Fromme and Godkin).

Kentucky: Where moisture was limited early in the season the disease was slight, but where heavy rains occurred while corn was small certain areas were quite badly injured, the root system being nearly destroyed. (Valleau)

Kansas: Somewhat more prevalent than usual, due probably to the unfavorable growing season. Twelve per cent loss. (Melchers).

Missouri: Loss about 25 per cent. In many fields there was 90 per cent lodging due to rotted roots. (Archer).

A loss of 25 per cent from root and ear rots together was estimated by Archer in Missouri. Other percentage losses reported were as follows: 15, Tennessee; 9, Maryland; 6, Indiana and Kansas; 5, Mississippi and Louisiana; 4, Pennsylvania, Alabama and South Dakota; 3, Virginia, Ohio, and Wisconsin; 2.8, North Carolina; 2.5, New Jersey and Michigan; 2, New York, West Virginia and Montana; 1, Minnesota; 0.5, Connecticut and Delaware; 0.2, Illinois.

In Wisconsin, Dickson (1) recommends planting disease-free, fire-dried, pedigree corn on clover or alfalfa land moderately early to prevent seedling blight and to secure the highest yield of well matured corn. If it is necessary to use diseased, poorly cured seed or to plant on old corn or wheat land, it should be planted in a warm soil to prevent seedling blight.

Recent literature:

1. Dickson, J. G. Making weather to order for the study of grain diseases. Wisconsin Agr. Exp. Sta. Bul. 379: 3-36 1926.

2. Dickson, J. G. and J. R. Holbert. The influence of temperature upon the metabolism and expression of disease resistance in selfed lines of corn. Jour. Amer. Soc. Agron. 18: 314-322. 1926.

3. Johle, R. A., F. W. Oldenburg, and C. E. Temple. Relation of internal cob discoloration to yield of corn. Phytopath. 16: 207-215. March 1926.

4. Valleau, W. D., P. E. Karraker, and E. M. Johnson. Corn root-rot a soil-borne disease. Jour. Agr. Res. 33: 453-476. 1926.

Corn - Ear Rots

EAR ROTS CAUSED BY GIBBERELLA SPP. AND FUSARIUM SPP.

Ear rots are very prevalent in all of the states east of the Great Plains especially in the central and southern parts of this area. In the western states outside of California they are of little importance.

Concerning the relative prevalence of ear rots in 1926, collaborators in Pennsylvania, Delaware, Maryland, and Arkansas reported much more, and in Louisiana, Indiana, Wisconsin, and Iowa, more than usual; otherwise there was about the average amount. Losses reported for 1926 are given in table 48.

Reports for certain individual states are as follows:

Pennsylvania: On account of extremely wet weather while the ears were developing, ear rots have been the most destructive I have ever observed. In many fields the percentage of ears showing symptoms and signs of rot are running between 80 and 90 per cent. Loss about 10 per cent. (Kirby).

South Carolina: Ear rots are abundant, at least in places this autumn. Part of this prevalence is doubtless due to unusual corn ear worm damage. Loss 5 per cent. (Ludwig).

Georgia: (Southern) Wet weather favored disease which caused about 6 per cent loss. (Boyd).

Louisiana: Heavy rains and storm in the southwest part of state favored root rots. Loss 10 per cent. (Tims).

Arkansas: Associated with extreme prevalence of corn ear worm. Loss 4 per cent. (Dept. Plant Path.)

Illinois: The Gibberella saubinetti type of ear rot is much more common than usual. Loss 1.2 per cent with an additional loss of 2.85 per cent due to the Fusarium moniliforme type. (Koehler).

Kansas: Less than usual due to dry season. Two per cent loss would probably cover it. (Melchers).

Missouri: About one-third of corn is badly rotted. Loss about 30 per cent. Farmers report heavy damage for last six years. (Archer).

California: Common in central and coastal areas. (Mackie).

The excessively wet weather which occurred in August and September over much of the central and eastern corn producing area is generally regarded as the cause for the marked increase in the amount of ear rot while to the westward, as in Kansas, abnormally dry weather was reported as holding the disease in check.

Table 48. Percentage losses from ear rots of corn, as estimated by collaborators, 1926.

Percentage loss	States reporting	Percentage loss	States reporting
25.	Missouri	1.5	Delaware, Alabama,
10.	Pennsylvania, Tennessee		Mississippi.
6.	Georgia	1.	Iowa
4.	Illinois	.6	Indiana
3.	North Carolina, Louisiana: Minnesota, South Dakota.	.5	Connecticut
		Trace	Massachusetts, New York,
2.	Maryland, Virginia		Florida, Texas,
	Kansas.		Wisconsin, North Dakota,
			Idaho, California.

Corn - Ear Rot: Bacterial Wilt: Brown Spot.

Recent literature:

1. Jehle, R. A., F. W. Oldenburg, and C. E. Temple. Relation of internal cob discoloration to yield of corn. Phytopath: 16: 207-215. 1926.

2. Jehle, R. A., F. W. Oldenburg, and C. E. Temple. Results of five years' selection for freedom from internal cob-discoloration in corn. (Abstract) Phytopath. 16 (9): 639. Sept. 1926.

3. Viber, T. The relation of temperature and moisture to diseased and disease-free corn. Philippine Journ. Sci. 31: 169-215. O. 1926.

BACTERIAL WILT CAUSED BY APLANOBACTER STEWARTII (EFS.) McC.

Bacterial wilt has been reported to the Plant Disease Survey from most of the states east of the Rocky Mountains. It is primarily a disease of sweet corn, but occurs on field corn also.

In 1926 bacterial wilt was reported as of about the usual prevalence. In most cases it was unimportant.

West Virginia: Observed only on sweet corn; occasional severe loss. (Sherwood).

Ohio: Serious losses are always noted on sweet corn. This disease is of increasing importance upon field corn. Loss 2 to 5 per cent. (R. C. Thomas).

Missouri: Present in garden lots of sweet corn over the state, causing moderate to slight loss. On pop corn it caused 10 per cent loss in a few small plantings in southeast Missouri. (Archer).

BROWN SPOT CAUSED BY PHYSODERMA ZEAE-MAYDIS SHAW.

Brown spot is primarily a disease of the South. It has been reported as far west as Kansas and Nebraska, and as far north as Ohio and New Jersey, but outside of the southern states it causes little or no loss.

In 1926 brown spot was slightly more destructive than in 1925. In southern Georgia, Boyd reported a 2 per cent reduction in yield with individual fields having one hundred per cent infection. Mississippi and Louisiana reported 1 per cent loss, and Alabama 0.5 per cent loss. Traces were reported from Missouri and Kansas.

OTHER DISEASES

Aspergillus sp., ear mold. Slight losses in certain local areas in Missouri. (Archer).

Basisporium gallarum M. Molliard, cob rot. General in Iowa. (Burns).

Bacterium dissolvens Rosen, bacterial stalkrot, was reported from Missouri for the first time by Archer who found it August 6, in Mississippi County, where it was causing about one per cent loss in one field. The determination was verified by Rosen.

Cephalosporium acremonium Cda. black bundle. Reported from three states in 1926. In Pennsylvania there was more than usual and it caused about 2 per cent loss as an ear rot. (Kirby). In Illinois the loss was 2 per cent. (Koehler). In Virginia it caused considerable loss as an ear rot in one field in Prince William County. (Fromme and Godkin).

Sorosporium reilianum (Kuehn) McAlp., head smut. Idaho and Washington.

Scutellum rot caused by various soil fungi was reported by Koehler in Illinois to cause an 8 per cent reduction in yield.

Ustilaginoidea sp., green smut, was reported with specimens from Summit, Canal Zone, by H. Johansen.

Recent literature:

1. Jehle, R. A., F. W. Oldenburg, and C. E. Temple. Relation of internal cob discoloration to yield of corn. Phytopath. 16: 207-215. 1926.

2. Kendrick, J. B. Holcus bacterial spot on species of Holcus and Zea mays. Phytopath. 16: 236-237. 1926.

3. Kunkel, L. O. The corn mosaic of Hawaii distinct from sugar cane mosaic. (Abstract) Phytopath. 17: 41. Jan. 1927.

4. McDonald, J. Diseases of maize and notes on a parasitic maize weed in Kenya. Kenya Dept. Agric. Bul. 4: 6 pp. 1926.

5. Nisikado, Y. and C. Niuyake. Studies on two Helminthosporium diseases of maize. Ber. Ohara Inst. Landw. Forsch. 3: 221-266. 1926.

6. Reed, G. M. Plant Pathology. Disease resistance - Fifteenth Ann. Rept. Brooklyn Bot. Gard., 1925, pp. 55-57, 1926.

7. Rosen, H. R. Bacterial stalk rot of corn. Phytopath. 16: 241-267. Apr. 1926.

8. Wolf, F. A. Tuckahoe on maize. Journ. Elisha Mitchell Sci. Soc. 41: 288-290. April, 1926.

Rice - Diseases
Flax - Diseases

RICE

Acrothecium sp., and Fusarium sp., on inflorescence, Porto Rico.

Piricularia grisea (Cke.) Sacc., blast. Florida, Texas, Arkansas, Porto Rico, of slight importance.

Sclerotium oryzae Catt., stem rot. Arkansas, loss 2 per cent. "Found in all sections on a few farms. Increasing slowly, more found every year. Often causes severe loss. A number of fields have been abandoned for rice growing. This is the most serious disease of rice in Arkansas by far." (V. H. Young).

Tilletia horrida Tak., black smut. This smut was found in Arkansas for the first time in 1926. V. H. Young and A. H. Prince discovered it in a field of long grain rice near Ulm, October 6. During a preliminary survey to determine its distribution, conducted by the Arkansas State Plant Board, the smut was found on nearly every place examined, always in minute amounts, however. Young reported that infection was greatest on the variety Fortuna, a long grain rice, but was seen on all types. The loss was very slight.

In the Check List of Diseases of Economic Plants (Dept. Bul. 1366) Tilletia horrida is reported from South Carolina, Georgia, Louisiana, and Arkansas. No records have been found to substantiate the report from Arkansas and it apparently had not been found in that state prior to 1926. The report from Georgia seems to be somewhat doubtful, as there were no specimens accompanying it. South Carolina and Louisiana are therefore the only states in which it is certain that the disease had occurred before 1926. In the Mycological herbarium of the Bureau of Plant Industry there are specimens from both of these states. Black smut was found in South Carolina in 1898, but apparently was eradicated or died out, as it has not been reported since 1899. The last year in which the disease was definitely reported to the Survey as having occurred in Louisiana was 1919, so that it would seem that the smut was at least of only slight importance.

Recent literature:

1. Palo, M. A. Rhizoctonia disease of rice. I. Philipp. Agr. 15: 361-375. Nov. 1926.
I. A study of the disease and of the influence of certain conditions upon the viability of the sclerotial bodies of the causal fungus.

2. Young, V. H. Black smut of rice discovered in Arkansas. Rice Jour. 29 (12): 13. Dec. 1926.

FLAX

Alternaria sp., boll disease. North Dakota, general in late flax

about Fargo. (Brentzel).

Colletotrichum linicolum Peth. & Laff., anthracnose. Wisconsin, fairly abundant on variety plats at Madison, not seen alsewhere. (Vaughan).

Fusarium lini Bolley, wilt, was reported from Wisconsin, Minnesota, Iowa, Missouri, North and South Dakota, Montana, and Idaho. Losses estimated were 10 per cent in North Dakota, 3 per cent in Montana, 1 per cent in South Dakota, .5 per cent in Minnesota, and a trace in Missouri. The disease caused less damage than usual in North Dakota and Minnesota, the axplanations suggested being too cool weather early in the season for its development in the former state, and too dry weather in the latter. The varieties Winona and Chippewa were reported as very resistant, and Minnesota 25 as very susceptible, from Minnesota.

Melampsora lini (Schum.) Desm., rust, was reported from Wisconsin, Minnesota, Iowa, North Dakota, South Dakota, and Oregon. The disease was severe in some fields of late flax in North Dakota, where the maximum infection observed was 50 per cent, and the total loss for the state 1.5 per cent, according to Brentzel. In Minnesota the loss was estimated at a trace, but in some fields it was from 5 to 25 per cent.

The reports from the recently developed fiber flax area in the Williamette Valley of Oregon are especially interesting. The rust has been collected there for the past two years, but 1926 is apparently the first time that it has caused damage. Barss reported that E. N. Bressman of the Oregon Agricultural College examined 8 fields, including 250 acres, in Marion County, and found the rust in every field. In some fields all of the stalks showed damage; in others as little as 5 to 10 per cent, according to Bressman. L. N. Dewey of the Office of Fiber Investigations, Bureau of Plant Industry, makes the following statement in a letter to A. G. Johnson, Office of Cereal Investigations:

> "This specimen was collected by Mr. B. B. Robinson of this Office in a field of fiber flax near Turner, Oregon, July 18, 1926. Mr. Robinson wrote that he had sent to Dr. Henry at St. Paul samples of rust flax from 20 different fields in Oregon. The flax growers there told him that nine-tenths of the fields were infested with this rust and some of them very badly. I fear this may prove a very serious handicap to the flax industry in Oregon, where about 4000 acres were grown last year and a little more than 3000 acres this year."

Henry (5) discusses the control of this rust, mostly from the standpoint of the development of immune varieties and strains. He states that there is some evidence of the existence of specialized physiologic forms.

Phlyctaena linicola Speg., pasmo. Minnesota and North Dakota were the only states reporting the occurrence of pasmo in 1926. In both there was less than usual, and the loss was a trace in each.

Polyspora lini Laff. Minnesota, one report.

Heat canker, non-par. North Dakota, loss 3.5 per cent; Montana, loss 2 per cent; Minnesota, loss a trace.

Recent literature:

1. Brentzel, W. E. The pasmo disease of flax. Jour. Agr. Res. 32: 25-37. 1926.

2. Brinsmade, J. C. Jr. Differences in wilt infection of flax varieties grown from seed of same sources at Fargo, St. Paul, and Mandan. Cereal Courier 18: 230. Aug. 10, 1926. (mimeogr.)

3. Dickson, J. G. Making weather to order for the study of grain diseases. Wisconsin Agr. Exp. Sta. Bul. 379: 3-36. Jan. 1926.

4. Hart, Helen. Factors affecting the development of flax rust, Melampsora lini (Pers.) Lév. Phytopath. 16: 185-205. Mar. 1926.

5. Henry, A. W. Flax rust and its control. Minnesota Agr. Exp. Sta. Techn. Bul. 36: 3-20. Mar. 1926.

6. Reynolds, E. S. Nutritional studies on Fusarium lini. Plant Physiology 1: 151-164. Apr. 1926.

7. Tochinai, Y. Comparative studies on the physiology of Fusarium lini and Colletotrichum lini. Jour. Coll. Agr. Hokkaido Imp. Univ., Sapporo, Japan. 14: 171-236. 1926.

S O R G H U M

COVERED KERNEL SMUT CAUSED BY SPHACELOTHECA SORGHI (LINK) CLINT.

Covered kernel smut has been recorded from most of the country. Only four states reported its occurrence in 1926 - Texas, Missouri, Kansas, and California. In both Kansas and California there was more than usual. Melchers estimated a loss of 10 per cent for Kansas, and stated that many fields showed from 50 to 85 per cent infection. Weather conditions were favorable and much contaminated seed was planted. From Texas and Missouri losses of 1/2 per cent and a trace were reported respectively.

The milo varieties, Dwarf and Double Dwarf were attacked by this smut in California, according to Mackie. Milo was affected in Texas also. Tisdale reported Feterita as resistant (2).

Melchers and Johnston (1) state that dust treatments of the seed with copper carbonate, flowers of sulfur, or "the more reduced sulfur dusts, such as 'Sulfodust' and 'Kolodust,'" are effective in the control of kernel smut. The copper carbonate treatment is widely used in Kansas. Tisdale (3) also recommends copper carbonate dust for the control of this smut.

Sorghum - Kernel Smut: Loose Kernel Smut:
Head Smut.

Recent literature:

1. Melchers, L. E., and C. O. Johnston. Sulphur and copper carbonate dusts as efficient fungicides for the control of sorghum kernel smut and millet smut. (Abstract). Phytopath 17: 52. Jan. 1927.

2. Tisdale, W. H. Recent progress in the control of cereal smuts. (Abstract). Phytopath. 16: 645-646. Sept. 1926.

3. Tisdale, W. H. Copper carbonate prevents bunt (stinking smut) of wheat. U. S. Dept. Agr. Circ. 394: 1-9. 1926.

LOOSE KERNEL SMUT CAUSED BY SPHACELOTHECA CRUENTA (KÜHN) POTTER

In 1926, loose kernel smut was reported only from Texas, where Taubenhaus estimated a loss of 2 per cent.

HEAD SMUT CAUSED BY SOROSPORIUM REILIANUM (KÜHN) MCALP.

Head smut does not seem to be quite so generally distributed as the covered smut, but it has, nevertheless, been reported over a wide area. In 1926 reports were received from South Carolina, Texas, Kansas, and California. No losses greater than a trace were reported. In California, according to Mackie, the disease seems to be disappearing. Melchers stated that head smut has never become an important disease in Kansas, probably being held in check by a combination of temperature and moisture conditions. The results of a preliminary study of the effect of soil moisture and temperature on infection of sorghum seedlings by head smut are reported by Christensen (1) as follows:

> "Seedlings of sorghum became infected in dry soil at temperatures ranging from 16° to 36° C. In moist soil no infection occurred at 16° C. The amount of infection was greatly reduced toward the two extremes of soil temperature. The optimum soil temperature for infection was 28° C. The minimum, and probably the maximum, fluctuates with the percentage of moisture in the soil. High soil moisture materially reduced the percentage of smutted plants at all temperatures and also narrowed the thermal range for infection."

Recent literature:

1. Christensen, J. J. The relation of soil temperature and soil moisture to the development of head smut of sorghum. Phytopath. 16: 353-357. May, 1926.

OTHER DISEASES AND INJURIES

Bacterium andropogoni EFS., bacterial stripe. Missouri, Kansas. A bacterial blight reported by Taubenhaus as due to Pseudomonas sorghi occurred in Texas.

Bacterium holci Kendrick, bacterial spot. Lafayette, Indiana, in Experiment Station plots. Kendrick (1) has described this species as the cause of a widespread bacterial spot of Holcus spp., corn and other grasses.

Helminthosporium turcicum Pass., leafspot. Missouri.

Phyllosticta sp., leafspot, was found on sorghum and broom corn in several localities in Missouri. The spots contained pycnidia of a Phyllosticta, presumably the P. sorghina Sacc. reported on Johnson grass in Texas by Wolf. (Archer).

Mosaic (virus). Louisiana, very common in sorghum fields; its significance uncertain. (Tims).

Recent literature:

1. Kendrick, J. B. Holcus bacterial spot on species of Holcus and Zea mays. Phytopath. 16: 236-237. Mar. 1926.

2. Lee, H. A. The common grasses in Hawaii in relation to mosaic or yellow stripe disease. Hawaiian Planters' Record 30: 270-278. Apr. 1926.

3. Walker, M. N. and C. F. Stahl. Certain grass hosts of the sugar cane mosaic disease and of the corn aphid considered in relation to their occurrence in Cuba. Trop. Plant Res. Foundation Bul. 5: 3-14. 1926.

B U C K W H E A T

Phyllosticta polygonorum Sacc., leafspot. Pennsylvania.

Ramularia anomala Pk., leafspot. Indiana.

Yellows, due to the aster yellows virus, identified by L. O. Kunkel. About 6 to 10 per cent of the plants in a three-acre field on the College Farm, New Brunswick, New Jersey, were affected. The effects of the disease show in the inflorescence - indefinite proliferation of flower buds and abundant production of small greenish flowers on long rather erect pedicels. (Dept. Plant Path.)

DISEASES OF FORAGE CROPS

ALFALFA

LEAF SPOT CAUSED BY PSEUDOPEZIZA MEDICAGINIS (LIB.) SACC.

In 1926 this leaf spot was reported from Connecticut, New Jersey, Mississippi, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, Kansas, Montana, Colorado, Arizona, Washington, and Oregon. In no one of these states was the loss estimated at more than a trace, which is the usual amount of injury.

In North Dakota, Brentzel indicated that the infection was much less important than usual, likely due to the dry weather prevailing during June and July. In Kansas, according to Weimer, there was a 5 to 10 per cent loss of leaves in some fields early in the season. In Arizona, Brisley remarked that ordinarily the disease is not evident until the second crop. In 1926, however, the first crop was attacked severely due to many rains during the spring. Defoliation was conspicuous, with an average of 25 per cent of the leaves involved. In Washington, Zundel said that almost complete defoliation of the first crop was reported from a number of places. In Oregon, according to Barss, the disease was common but rarely serious.

YELLOW LEAF BLOTCH CAUSED BY PYRENOPEZIZA MEDICAGINIS FCKL.

South Carolina, Iowa, Kansas, Utah, Arizona, Idaho, and Washington reported the presence of this leaf spot, in 1926. In Kansas, Weimer and Melchers indicated that it was prevalent early in the season causing a loss of 25 to 50 per cent of the leaves in some fields, but later in the season it was uncommon because of dry weather. In Utah the disease was reported by Richards to be serious for the first time. Infection was 100 per cent in Utah and Cache Counties and many plants were practically defoliated.

DOWNY MILDEW CAUSED BY PERONOSPORA TRIFOLIORUM D BY.

Downy mildew was reported from Connecticut, Kentucky, Illinois, Iowa, Kansas, Montana, Colorado, Utah, and Idaho. Evidently the disease was of the usual minor importance.

Clinton remarked that the disease was noted by him for the second time in Connecticut. In Iowa, M. H. Burns reported local damage to the extent of

5 per cent. In Kansas, according to Melchers, there was no appreciable damage, although the disease could be found on the first crop in fields of all ages. In Colorado, Learn remarked on the unusual occurrence of the disease in the third cutting, as ordinarily it is found only in the first crop. Sometimes entire plants were dwarfed and discolored. The first crop was severely damaged in many localities in Utah, according to Richards.

BACTERIAL STEM BLIGHT CAUSED BY BACTERIUM MEDICAGINIS (SACK.) EFS.

Bacterial stem blight was reported in 1926 from Kansas, Arizona, and Idaho. In Kansas it was generally prevalent before the first cutting, according to Weimer. In northern Arizona, Brisley reported that it was present in all fields, but was not so severe as usual, being confined mostly to leaf and petiole infection. He stated that the spring was wet, with very little frost, and this condition is thought to account for the comparative absence of stem infection.

BACTERIAL ROOT ROT CAUSED BY APLANOBACTER INSIDIOSUM McCULLOCH.

This root rot, the causal organism of which was found in 1925, has been reported from many scattered states. In 1926, one new state, Minnesota, was added to the list, making a total of 18, as indicated in the accompanying map (Fig. 19) which is based on data secured from reports to the Plant Disease Survey and from recent literature (see Jones and McCulloch (1). In addition to Minnesota, already mentioned, reports of the occurrence of the disease in 1926 were received from Illinois, Iowa, Missouri, Kansas, and Mississippi.

The following data deal with severity and occurrence of the disease in various states:

Mississippi: Severe in Washington County; slight in Coahoma and Monroe. (Neal).

Illinois: Loss 1 per cent. Fields that were known to be infected last year have all been turned under. The loss this year is practically all in new fields. (Koehler).

Minnesota: First report for the state, 1 to 2 per cent infected plants found in the original field in Carver County where Grimm alfalfa was introduced from Germany in 1857. (Sect.Pl. Path.)

Iowa: Local. Five per cent reduction. (Burns).

Missouri: The disease was definitely associated with the causal organism for the first time in the state by Irl T. Scott. Infested fields were located in eight counties scattered along the outer borders of the state but undoubtedly the disease is present also in all parts of the state. Many fields are a total loss and it is likely that as new plantings mature they will succumb in turn. The estimated loss for the state is 25 per cent. (Archer).

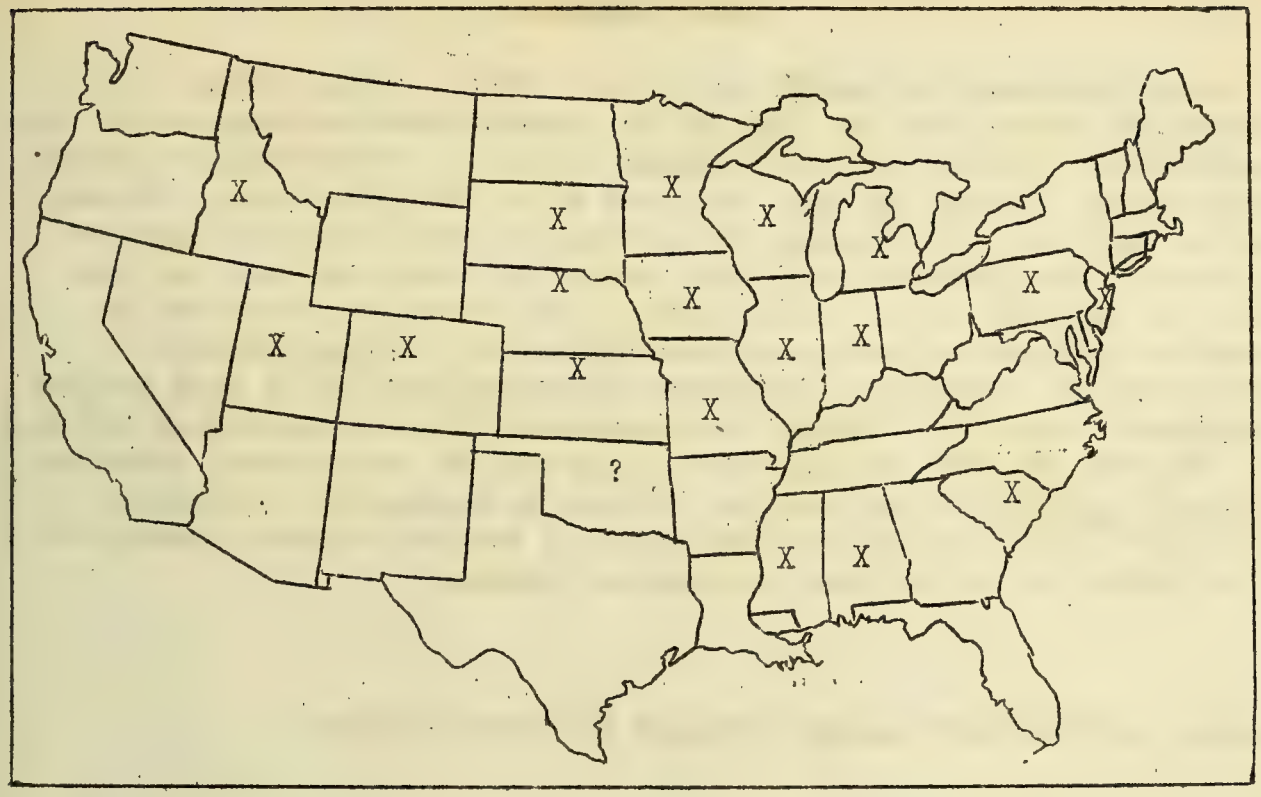

Fig. 19. Distribution of bacterial wilt of alfalfa in the United States, 1925 and 1926.

Kansas: The disease has been located in all counties where alfalfa is grown. It was very prevalent in the first crop and it is found in fields of all ages. Loss for state is estimated at 5 per cent. (Melchers)

Common especially in eastern Kansas. Some fields show practically 100 per cent infection. (Weimer)

Large acreages of older fields have been abandoned because of this disease. (White)

Recent literature:

1. Jones, F. R., and L. McCulloch. A bacterial wilt and root rot of alfalfa caused by Aplanobacter insidiosum L. McC. Jour. Agr. Res. 33: 493-521. Sept. 15, 1926.

STEM ROT AND CANKER CAUSED BY CORTICIUM VAGUM BERK. & CURT.

In southeastern Kansas, Weimer has found instances where alfalfa stems were white for an inch or more above the surface of the ground due to the presence of the perfect stage of this fungus. Small stem cankers were sometimes present. In southeastern Missouri, Archer found extensive stem infection in the form of cankers. The lesions had the appearance of those caused by the common anthracnose organism (Colletotrichum trifolii) but no spores or fruiting structures of this organism were found. Similar lesions were found,

to a less extent however, on nearby red clover plants. The lesions start as small brownish areas near the base of the stems, which enlarge until the stem is encircled, then the involved tissue takes on a water-soaked appearance and may become flaccid so that the stem wilts or falls over. In many such cases the infected plant sends up new shoots from below the cankered area, and several observations were made where the stalk had put out new roots above the injured area. Tissue isolations, both by Weimer and by Archer, yielded cultures of a Rhizoctonia (probably R. Solani Kuehn). There seems to be no literature reference of the occurrence of this fungus in stem lesions of alfalfa. Weimer was unsuccessful in obtaining artificial infection. He remarks that he has often isolated the anthracnose organism (Colletotrichum trifolii) from similar lesions in Kansas and that he is inclined to believe that the initial infection is due to Colletotrichum with Rhizoctonia following in the dead or weakened tissue.

CROWN AND ROOT ROT CAUSED PROBABLY BY WINTER INJURY

Crown rot was reported in 1926 from Wisconsin, Minnesota, Missouri, Kansas, and Colorado. Weimer in Kansas, I. T. Scott in Missouri, and the Section of Plant Pathology in Minnesota report the finding of various fungi, especially Fusaria, associated with the rotted crown tissue. Weimer, however, is inclined to believe that the fungi are secondary invaders of tissue injury by low winter temperatures. In Wisconsin, Missouri, and Kansas also, the crown rot injury was further complicated by association with the bacterial wilt (Aplanobacter insidiosum).

In Wisconsin, according to Vaughan, the disease is extensive in southern and eastern sections. In Missouri, Archer estimates the loss to be 25 per cent. He states that this injury bids fair to be the limiting factor in the culture of the crop. Several thousand acres were abandoned or plowed up in 1926. In Kansas, Melchers and Weimer estimate the loss to be 3 per cent. They state that "Winter injury is a very general term since the factors entering into it are not well understood. The problem together with crownrot is being extensively investigated here. Many fields have been so badly killed out that they have been plowed up. The life of other fields has been much shortened." In Colorado, Learn reports that a root rot is very prevalent in alfalfa districts and that it has been serious in some cases. In Minnesota, the Section of Plant Pathology reports the occurrence of a root rot in the northern part of the state, although the extent of the damage is not known.

STEM NEMATODE CAUSED BY TYLENCHUS DIPSACI (KUEHN) BAST.

Records of the Plant Disease Survey show that this nematode has been found on alfalfa in Illinois, Nebraska, Colorado, New Mexico, Arizona, Utah, Idaho, Washington, Oregon, and California. In 1926 the eleventh state, Kansas, was definitely added, although Melchers stated that the disease had been reported twenty years ago. Besides Kansas the disease was reported in

1926 from Colorado, Washington, and Oregon. In Washington, Zundel reported that the nematode is gradually killing out large areas and is becoming more serious each year. In Oregon, according to McKay, it is not known exactly how fast the pest is spreading nor how much damage is done but that certainly it will persist and spread in the areas where it now occurs beyond hope of eradication.

WHITE SPOT (UNDETERMINED.)

White spot was reported from Utah and Connecticut. Hill states:

"White spot has been known to occur in Utah for a number of years. In 1926 it was particularly severe in many fields in the northern portion of the state and undoubtedly reduced the yield materially. It is worse on well drained land which becomes dry quickly. In a number of instances a severe outbreak was brought on by the application of cold mountain irrigation water during a very hot day. In a few fields the appearance of the disease was much the same as sulfur dioxide injury, for which it has been mistaken by a number of farmers in the districts surrounding smelters. It can be clearly distinguished from sulfur injury by the progressive development which usually occurs from the basal leaves to the newly formed leaves, by the nature and location of the white spots that occur on most of the affected leaves, and by the fact that alfalfa is the only plant affected; whereas in sulfur dioxide injury there are usually a number of weeds also sensitive to sulfur injury which show markings as well as alfalfa.

"In some cases the white spot appeared rather suddenly on most of the leaves of an alfalfa shoot, in other cases there was a progressive development, lasting over at least three weeks. In some cases there seems to have been a regeneration of chlorophyll in the whitened areas, though this statement needs checking. In a large number of fields, with the resumption of warm weather, the alfalfa outgrew the trouble."

YELLOWS (UNDETERMINED.)

Yellows was reported from Maryland, Michigan, Illinois, Wisconsin, Kansas, and Washington. This disease has been reported under various names as yellow leaf, yellow top, yellow blotch, hopperburn, etc. Recent investigations by Jones and Granovsky (1) indicate that the leafhopper Empoasca fabae is responsible for the trouble.

In Michigan, Kotila found the disease to be more severe than usual, especially in Berrien and Kent Counties. He states:

Alfalfa Yellows: Other Diseases.

"Variety plots at the Experiment Station show varying degrees of injury and some varieties are seemingly resistant. On close inspection the yellowed foliage shows a pink color. The tips of severely injured leaves turn brown. Leafhopper adults and nymphs were very abundant on diseased plants."

In Illinois, Koehler estimates the reduction in yield to be 20 per cent. In Kansas, Melchers states that yellows is practically limited to the first crop.

Recent literature:

1. Jones, Fred R., and A. A. Granovsky. Yellowing of alfalfa caused by leafhoppers. (Abstract). Phytopath. 17: 39. 1927.

OTHER DISEASES

Ascochyta imperfecta Pk., leaf spot. Caused minor damage in New Jersey, Missouri, and Kansas.

Caconema radicicola (Greef) Cobb, root knot. Scattered traces found in Texas where irrigation is retarded or neglected. Important where hairy Peruvian is not grown. (Taubenhaus)

Cercospora medicaginis Ell. & Ev., leaf spot. Losses estimated as a trace in Texas and Missouri. In Kansas it occurs commonly in latter part of season, causing a loss of a trace to 0.5 per cent defoliation in some fields.

Colletotrichum trifolii Bain, anthracnose. Present in some fields in Kansas. A few plants killed.

Cuscuta sp., dodder. Washington and Texas.

Macrosporium sp., leaf blotch. Reported this year only from New Jersey and Missouri. In Missouri the fungus causes insignificant losses in an average year. In 1926, however, a number of young fields had been subjected to an unusual drought and in these fields the plants were practically defoliated and sometimes killed by the attack of the fungus. Neighboring fields of sweet and red clover were attacked also but to a less degree. Losses were confined to the southeastern part of the state, particularly St. Francois County. (Archer)

Ozonium omnivorum Shear, root rot. Reported from Texas and Arizona. The loss in the latter state is estimated at 3 per cent.

Pleosphaerulina briosiana Poll., leaf spot. Kansas.

Sclerotinia trifoliorum Eriks., stem rot. Reported from Virginia, Oregon, and Washington. In Washington, Zundel reported that the disease occurred on one and two-year old plants, the infection ranging from a trace to 90 per cent.

Uromyces medicaginis Pass., rust. Reported from New Jersey, South Carolina, Mississippi, Louisiana, Texas, Missouri, Kansas, and Arizona. Losses are estimated as a trace in Missouri and Kansas. In Kansas, Weimer stated that after heavy rains in September some defoliation occurred. Brisley

reported that the disease was found in neglected fields in Arizona. Where the crop is allowed to stand too long before cutting, the resultant hay is sometimes conspicuously browned. The trouble occurs only on the fourth crop.

Urophlyctis alfalfae (Lagh.) Magn., crown wart. Reported from Alabama, Mississippi, Texas, Oregon, and Washington. In May, 1926, Weimer (3) found the disease in two fields near Muldon and in two fields near Columbus, Mississippi. He also found it in three fields in Alabama. These, together with a report from Miles of Alabama, constitute the first authentic reports from the Southern States.

Recent literature:

1. Mains, E. B. Studies in rust resistance. Jour. Heredity 17: 313-325. Sept. 1926.

2. Oakley, R. A., and H. L. Westover. Commercial varieties of alfalfa. U. S. Dept. Agr. Farm. Bul. 1467: 1-21. Feb. 1926.

3. Weimer, J. L. Crown wart of alfalfa in the South. Phytopath. 16: 1012. Dec. 1926.

C L O V E R

POWDERY MILDEW CAUSED BY ERYSIPHE POLYGONI DC.

Powdery mildew was reported in 1926 from 12 widely scattered states; Connecticut, New Jersey, Delaware, Virginia, North Carolina, South Carolina, Georgia, Indiana, Missouri, North Dakota, Oregon, and Washington. In general it seemed to be less prevalent than usual, although in Virginia, South Carolina and Indiana it was said to be as prevalent as in 1925. The following dates of earliest recorded appearances were submitted: May 10, Clemson Agricultural College, South Carolina; June 14, New Castle County, Delaware; June 15, Marshall, North Carolina; June 27, Caldwell County, Missouri; June 30, Bristol, Virginia; August 2, Monmouth County, New Jersey; July 2, East Haven, Connecticut; July 16, Spaulding County, Georgia.

In North Dakota Brentzel reported that infection was not found by August 1, although in past years it had been abundant. Zundel stated that the disease is becoming more prevalent in Washington each year. In Georgia, according to Higgins, the disease was formerly consistently present on all clover plants, but in 1926 up to the middle of July only a single infected volunteer plant was found. In Oregon, Barss mentions the marked difference in susceptibility of various seed strains and individual plants.

Clover - Powdery Mildew - Other Diseases.

Recent literature:

1. Barss, H. P. Clover mildew. Oregon Agr. Coll. Ext. Service Circ. 227. 1-2. (Mimeogr.). May, 1926.

2. Delwiche, E. J. Tests of strains of Red Clover from various sources. Jour. American Soc. Agron., 18 (5): 393-403. 1926.

OTHER DISEASES

Bacterium trifoliorum Jones, leaf spot. In Indiana it was first observed May 17 at Lafayette. The loss for the state, caused primarily through severe defoliation, was estimated at 0.3 per cent. Alsike is considered to be immune. Canadian strains were resistant in Wisconsin, Oregon, Tennessee, Minnesota, Ohio, and Indiana. Foreign strains, especially Roumanian, French, and Hungarian were very susceptible. (Mains)

Gloeosporium caulivorum Kirchner, anthracnose. In Indiana the disease was first observed May 17 at Lafayette in test plots. North American strains were resistant, while the Altasweet variety, Italian, and French strains were susceptible. (Mains). Also reported from New Jersey by Dept. Pl. Path.

Macrosporium sp., leaf blotch. Reported in Missouri on plants weakened by drouth. A 50 per cent infection was found in several fields but the loss for the state is estimated as a trace. The same fungus was found on nearby alfalfa plants where the infection was more severe.

Phyllachora trifolii (Pers.) Fckl., sooty spot. Reported byHaenseler to be severe in two localities in New Jersey on White Dutch clover.

Sclerotinia trifoliorum Eriks., root rot. Reported from Virginia, Washington, and Oregon. In Oregon Barss reports less injury than usual, due perhaps to dry weather conditions which prevailed during the spring months.

Tylenshus dipsaci (Kuehn) Bast., stem nematode. Washington and Oregon.

Uromyces trifolii (Hedw. f.) Lev., rust. On alsike in Indiana and on red clover in Connecticut. U. trifolii-repentis (Cast.) Liro on white clover in Connecticut. U. hybridi Davis on alsike in Connecticut chiefly along roadsides. U. fallens (Desm.) Kern. on red clover in New Jersey.

Root and crown rot (undet.) Apparently a vascular trouble possibly caused by a Fusarium, reported from Indiana. French and Italian strains are very susceptible. (Mains)

Mosaic (virus). Caused a reduction in yield of 0.5 per cent in Indiana where no varieties were immune. (Mains).

Recent literature:

1. Hallowell, E. A., John Monteith, Jr., and W. P. Flint. Leafhopper injury to clover. (Abstract) Phytopath. 17:58. 1927.

2. Hodson, W. E. Notes on the stem eelworm. Jour. Min. Agr. Great Britain 33: 259-262. June 1926.

Clover - Other Diseases.
Sweet Clover - Diseases.
Cowpea - Wilt.

3. Pieters, A. J., and J. Monteith. Anthracnose as a cause of red clover failure in the southern part of the clover belt. U. S. Dept. Agr. Farm. Bul. 1510: 1-17. Nov. 1926.

4. Wellensiek, S. J. Waarnemingen over de klaverstengelbrandziekte. Tijdschr. Plantenz. 32: 266-302. Oct. 1926. (English summary: Observations on clover anthracnose. pp. 295-298)

SWEET CLOVER

Macrosporium sp., leaf blotch. Occurred in Missouri on plants weakened by drought. Nearby red clover and alfalfa plants were also attacked. (Archer).

Mycosphaerella lethalis Stone, stem spot. Common in Missouri.

Canker (Undet.) Missouri; occurring on drought-weakened plants and was associated with a similar trouble on alfalfa and red clover. The lesions resembled Colletotrichum infection but no spores were present. Tissue cultures from alfalfa yielded a Rhizoctonia. (Archer).

COWPEA

WILT CAUSED BY FUSARIUM VASINFECTUM TRACHEIPHILUM EFS.

Wilt was reported from Texas, Virginia, South Carolina, and Missouri. In southeastern Missouri, especially in Scott and Mississippi Counties, Archer found several fields which were a total loss. The loss for the state is estimated at 10 per cent. Since cowpeas are proving to be more susceptible each year county agents are endeavoring to substitute soybeans, which are obviously not subject to the wilt. The loss in Texas is estimated at 2 per cent.

Recent literature:

1. Weimer, J. L. and L. L. Harter. Root rot of the bean in California caused by Fusarium martii phaseoli Burk. and F. aduncisporum n. sp. Jour. Agr. Res. 32: 311-319. 1926.

SCAB CAUSED BY CLADOSPORIUM VIGNAE GARDNER

Scab was reported from Delaware, Virginia, Alabama, and Arkansas. All four states are new localities for the disease which was described as new only last year in Indiana by Gardner. It is evident from the following reports of collaborators that the disease was epidemic in 1926 and it will be interesting to note its development next season.

In Delaware, Adams reported the disease from two localities where it had slight importance. In Virginia, Fromme remarked that the disease has been present for a number of years. In 1926 it was collected from five different localities in all of which severe injury occurred. Iron, Hull, and Clay varieties seem to be immune, while Whippoorwill and especially Blackeye are susceptible. In Alabama, Miles reported the severe occurrence of the disease in two fields of Blackeye where the loss was practically complete. He stated that other fields in the same locality, of the same variety but from seed of other sources, were unaffected. Wingard, of Virginia, also reports finding the disease in Alabama in Montgomery County. He states:

> "The Blackeye variety showed 100 per cent infection on pods, stems and leaves; many of the young pods being completely destroyed before any seed were formed. Other varieties of cowpeas growing in other parts of the same field showed no infection. The infection was thought to general in the vicinity of Grady. The rainfall for this section was very heavy and no doubt accounts for this severe infection."

In Arkansas, V. H. Young reports that the disease was formed in several localities causing severe loss on Blackeye.

OTHER DISEASES

Bacterium phaseoli EFS., bacterial blight. Traces in Texas.

Bacterium vignae Gard. & Kendr., bacterial spot. Moderate importance in Indiana.

Caconema radicicola (Greef) Cobb, root knot. Virginia and South Carolina.

Cercospora cruenta Sacc., leaf spot. Reported from Texas with loss of 0.5 per cent. Also in Delaware and Florida.

Phoma bakeriana Sacc. Reported by Wedgworth from Mississippi on pods. According to Diehl the fungus is similar to Phyllosticta phaseolina Sacc.

Mosaic (virus). In Indiana Gardner reported that mosaic was serious in plots on 12 varieties and also on Vigna catjang. Evidence obtained in field plots with single plant selections of seed indicates

that mosaic is seed borne in the Progressive White variety.

Ozonium omnivorum Shear, root rot. Loss 0.5 per cent in eastern Texas.

Recent literature:

1. Gadd, C. H., and L. S. Bertus. A Rhizoctonia disease of Vigna. Year Book Dept. Agr. Ceylon 1926: 31-33. 1926.

S O Y B E A N

Bacterium glycineum Coerper, bacterial blight. Reported from Tennessee, Indiana, and Kansas. Weimer states that this blight is widespread in Kansas and that it was responsible for a loss of 1 to 5 per cent of lower leaves.

Bacterium phaseolii sojones Hedges, bacterial pustule. Reported from Delaware, Missouri, and Kansas. In Missouri both the Laredo and Virginia varieties were attacked although injury seemed to be minimal. Weimer considers pustule to be widespread in Kansas although not so prevalent nor appearing quite so early as bacterial blight.

Botrytis sp., grey rot. On leaves in Connecticut.

Cercospora sp., leaf spot. North Carolina and Louisiana.

Fusarium sp., pod spot. Fromme reported that in one locality in Virginia pods of Virginia soybeans showed spots with Fusarium fruiting on them.

Glomerella glycines (Hori) Lehman and Wolf, anthracnose. The authors (3) have studied this disease in North Carolina and consider it to be distinct from G. cingulata.

Peronospora sojae Wolf, downy mildew. Generally found in Delaware on Wilson variety according to Adams but not showing evidence of injury. Wolf and Lehman (6) decide that P. sojae is to be considered as a synonym of P. manshurica (Naumoff) Sydow.

Pythium debaryanum Hesse, root rot. Described by Lehman and Wolf (2) from North Carolina.

Septoria glycines Hemmi. Reported from Delaware, North Carolina (5), and Indiana.

Mosaic (Virus). Reported from Indiana and Kansas. In Indiana a six acre field of Midwest variety was rejected for seed certification. In Kansas scattered infection was observed early in July but was more prevalent later. The loss is estimated as a trace.

Recent literature:

1. Burgwitz, G. K. Bacterial blight and spotting of soybean (Glycine hispida Maxim.) Morbi Plantarum, Leningrad 14: 38-41. 1925.

2. Lehman, S. G., and F. A. Wolf. Pythium root rot of soybean. Jour. Agr. Res. 33: 375-380. Aug. 15, 1926.

Soybean - Diseases
Vetch
Kudzu - Diseases

3. _____ Soybean anthracnose. Jour. Agr. Res. 33: 381-390. Aug. 15, 1926.

4. Mendiola, N. B., and G. O. Ocfemia. The work of breeding disease resistant crop plants at the College of Agriculture at Los Banos. Philipp. Agriculturist. 15: 117-128. Aug. 1926.

5. Wolf, F. A., and S. G. Lehman. Brown spot disease of soybean. Jour. Agr. Res. 33: 365-374. August 15, 1926.

6. _____ Diseases of soybeans which occur both in North Carolina and the orient. Jour. Agr. Res. 33: 391-396. Aug. 15, 1926.

V E T C H

Mycosphaerella sp., leaf spot. South Carolina.

K U D Z U

Bacterium pueriae Hedges, bacterial halo spot. This new disease is described and the organism tentatively named by Hedges (1). The disease was first reported in 1924 by Clinton from Connecticut in Plant Disease Reporter Supplement 42: 354. In 1926 Boyd reported for Southern Georgia as follows:

"The first report of this disease from Georgia was made in 1925 from Grady County. In Worth County in 1926 a second field was visited in which about 5 acres of a 30-acre field shows heavy infection, with probably 90 per cent leaf infection and numerous petiole and runner lesions. It is estimated that about 10 per cent of the leaves are killed. The diseased area was planted with cuttings from a different source than the unaffected area of the field. The grower is contemplating eradicating the disease by pulling the vines and burning, in order to prevent spread of the disease to the healthy area. The planting is two years old. It is surprising to note that the disease should make such rapid progress in 1926, since the months of May and April have been relatively dry. The loss for the state is estimated at 1 per cent. Fields vary greatly in severity of infection but in general there is less damage in the lower, damper fields."

Kudzu - Diseases
Guar
Sunflower - Diseases
Grasses - Diseases

Caconema radicicola (Greef) Cobb, root knot. Loss 1 per cent for Georgia. One field in Worth County had 50 per cent infection and apparently the infection had developed during the winter months. (Boyd)

Recent literature:

1. Hedges, Florence. Bacterial halo spot of kudzu. (Abstract) Phytopath. 17: 48. 1927.

G U A R

Sclerotium rolfsii Sacc., southern wilt. Loss a trace in eastern Texas.

S U N F L O W E R

Erysiphe cichoracearum DC., powdery mildew. New Jersey, severe infection observed in one planting. Reported also from New York.

Plasmopara halstedii (Farl.) Berl. & de Toni, downy mildew. Collected at Bozeman, Montana, by R. J. Haskell and P. A. Young.

Puccinia helianthi-mollis (Schw.) Jackson, rust. Reported from Connecticut, New Jersey, Minnesota, and Missouri. In Connecticut the rust was found on wild plants. In Missouri it was found on Giant and double-flowered varieties.

Rhizoctonia (probably R. solani), stem rot and wilt. New York,
Sclerotinia sp., wilt. Washington.
Septoria helianthi Ell. & Ev., leaf spot. Connecticut.

Recent literature:

1. Nishimura, M. Studies in Plasmopara halstedii. Jour. Coll. Agr. Hokkaido Imp. Univ. 17: 1-61. Apr. 1926.

G R A S S E S

Bacterium holci Kendrick
Holcus sorghum sudanensis - Indiana.

Claviceps purpurea (Fr.) Tul.
Lolium perenne - Washington.
Phalaris arundinacea - Pennsylvania.

Colletotrichum graminicolum (Ces.) Wils.
Agropyron repens - Pennsylvania.
Agrostis palustris - Pennsylvania.
Bromus secalinus - Pennsylvania.
Dactylis glomerata - Pennsylvania.
Festuca elatior - Pennsylvania.
Holcus sorghum sudanensis - Missouri.
Poa pratensis - Pennsylvania.

Erysiphe graminis DC.
Agropyron repens - Pennsylvania.
Poa pratensis - South Dakota.

Helminthosporium turcicum Pass.
Holcus sorghum sudanensis - North Carolina.

Helminthosporium vagans Drechsler
Poa pratensis - Pennsylvania.

Fuligo ovata
Golf greens - Connecticut

Phyllachora graminis (Pers.) Fckl.
Agropyron repens - Pennsylvania.

Physarum cinereum
Poa pratensis - Kentucky.

Piricularia grisea (Cke.) Sacc.
Digitaria sanguinalis - Missouri.

Puccinia clematidis (DC.) Lagh.
Agropyron repens - Pennsylvania.
Elymus glaucus - Montana.

Puccinia coronata Cda.
Festuca elatior - Pennsylvania.

Puccinia epiphylla Wetts.
Poa pratensis - Pennsylvania.
Poa sp. - Wyoming.

Puccinia glumarum (Schm.) Eriks. & Henn.
Aegilops cylindrica - Washington.
Elymus sp. - Washington.

Puccinia graminis Pers.
Agrostis palustris - Pennsylvania.
Agropyron repens - Pennsylvania.

Bromus secalinus - Pennsylvania.
Festuca elatior - Pennsylvania.
Hordeum jubatum - Colorado.
Phleum pratense - Pennsylvania, Missouri, Connecticut.
Poa compressa - Pennsylvania, Michigan, Virginia.
Poa pratensis - Indiana.

Sclerotrichum graminis Fckl.
Poa pratensis - Indiana.

Sorosporium syntherismae (Peck) Farl.
Panicum proliferum - New Jersey,

Tilletia asperifolia Ell. & Ev.
Sporobolus asperifolia - Utah.

Tilletia holci (West.) Rostrup
Notholcus lanatus - Washington, Oregon.

Tolyposporium bullatum Schroet.
Echinochloa crus-galli - Connecticut.

Ustilago bromivora (Tul.) Fisch.
Bromus tectorum - Washington, Wyoming, Utah, Idaho, Oregon.
Bromus sterilis - Washington.

Ustilago crameri Koern.
Chaerochloa italica - Connecticut.

Ustilago crus-galli Tracy & Earle
Echinochloa crus-galli - Connecticut.

Ustilago hypodytes (Schlecht.) Fr.
Eriocoma cuspidata - Washington.

Ustilago lorentziana Thuem.
Hordeum jubatum - Idaho, Utah, Washington.

Ustilago rabenhorstiana Kuehn.
Digitaria sanguinalis - Missouri, New Jersey.

Ustilago striaeformis (West.) Niessl.
Dactylis glomerata - Pennsylvania, New York.
Phleum pratense - Pennsylvania.
Poa pratensis - Pennsylvania, Indiana.

Recent literature:

1. Bauch, R. Untersuchungen über die entwicklungsgeschichte und sexualphysiologie der Ustilago bromivora und Ustilago grandis. Zeitschr. Bot. 17: 129-177. 1926.

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2. Bayliss Elliott, Jessie S. Concerning 'Fairy rings' in pastures. Ann. of Appl. Biol. 13 (2): 277-288. 1926.

3. Davis, W. H. Life history of Ustilago striaeformis (Westd.) Niessl. which causes a leaf smut in timothy. Jour. Agr. Res. 32: 69-76. Jan. 1, 1926.

4. Dietz, S. M. The effect of the alternate hosts on physiologic forms. (Abstract) Phytopath. 16: 83-84. 1926.

5. Fraser, W. P., and G. A. Scott. Smut of western rye grass. Phytopath. 16: 473-477. July, 1926.

6. _____, P. M. Simmonds, and R. C. Russell. The take-all disease in Canada. (Abstract) Phytopath. 16: 80-81. 1926.

7. Kendrick, J. B. Holcus bacterial spot on species of Holcus and Zea mays. Phytopath. 16: 236-237. 1926.

8. Lee, H. A. The common grasses in Hawaii in relation to mosaic or yellow stripe disease. Hawaiian Plant. Rec. 30: 270-278. Apr. 1926.

9. McLennan, E. The endophytic fungus of Lolium II. The mycorrhiza on the roots of Lolium temulentum L., with a discussion on the physiological relationships of the organism concerned. Ann. Bot. 40: 43-68. Jan. 1926.

10. Mains, E. B. Studies in rust resistance. Jour. Heredity 17: 313-325. Sept. 1926.

11. Melhus, I. E., Frank Van Haltern, and D. E. Bliss. A study of the downy mildew, Sclerospora graminicola (Sacc.) Schroet. (Abstract) Phytopath. 17: 57. 1927.

12. Monteith, J. Jr. The relation of mushroom soil to brown patch. Bul. Green Sect. U. S. Golf Assoc. 6: 119-120. May 1926.

13. _____ The brown patch disease of turf: its nature and control. Bul. U. S. Golf Assoc. Green Sect. 6: 127-142. June 1926.

14. _____ Corrosive sublimate as a control for brown patch. Bul. U. S. Golf Assoc. Green Sect. 6: 151-155. July 1926.

15. Monteith, John Jr., and T. Carter Harmon. Fungicidal control of brown-patch of turf. (Abstract) Phytopath. 17: 50. 1927.

16. Pape, Heinrich. Die sclerotium-krankheit der wiesengraser insbesondere des rohrglanzgrasses. Illus. Landw. Zeit. 46: 295-296. June 4, 1926.

17. Weston, W. H., and G. F. Weber. Downy mildew (Sclerospora graminicola (Sacc.) Schroet.) on the Everglade Millet (Chaetochloa magna (Griseb.) Scribn.) (Abstract). Phytopath. 16: 71. 1926.